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Practical Teacher
A MONTHLY EDUCATIONAL JOURNAL.
Edited by JOSEPH HUGHES.

'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

VOL. XVI. No. 4. OCTOBER, 1895. PRICE, 6D. POST FREE, 8D.

WELL-KNOWN TEACHERS AT WORK.

XLIV.—MR. J. E. ELLSON,

Hugh Myddelton School, Clerkenwell.

Of the four hundred and thirty or forty schools now in operation under the control of the School Board for London, the one known as the Hugh Myddelton School may lay claim to be the largest, the finest, the most costly, and the most complete.

As to its size, it may be noted that the site measures nearly 2½ acres, or about 100,000 square feet; and while the main building affords accommodation for 600 boys, 600 girls, and 800 infants, or 2,000 in the three departments, subsidiary buildings grouped around it will accommodate some 300 more pupils in special central classes.

The building, designed by Mr. Bailey, the Board's architect, is of fine appearance, being a lofty and massive structure of various coloured bricks, effectively relieved by dressings of terra-cotta for the upper storey.

The principal building consists of three floors on an almost identical plan, the ground floor being occupied by the infants, the intermediate one by the girls, and the upper by the boys. On each floor is a large central hall, about eighty feet long from east to west, and fifty wide from north to south. The hall of the boys' department is particularly effective, by reason of the bold architectural design of its partly open roof, supported by large girders painted in two tints of buff and brown, the rivets being picked out in the darker shade. By a skilful arrangement, excellent lighting is obtained from windows at each end as well as from dormer windows in the roof. The walls all round are lined with white glazed bricks. The great width of the halls makes it important that columns should be introduced as supports to the floors and roof, and these are made to add to the effect by forming a sort of arcade along the north side of the hall. From this arcade may be reached a range of four class-rooms, each measuring about 26 feet square, and seated for sixty pupils. At one end of these class-rooms is a commodious room for the head teacher, and at the opposite end a similar one for the class teachers. Another series of six class-rooms extends along the south side of the hall, two of which accommodate fifty pupils each, two sixty each, and two seventy each. Over these last are two extra rooms, one used for manual training in woodwork, and the other as an art-room. A cap and cloak room and a separate staircase are placed at each end of the hall.

Along the centre of one side of the hall is a raised platform measuring about 30 feet by 10 feet, and having a handsome balustrade at the front and ends.

The total cost of the school exceeds £60,000, about a third of it being expended on the site. The great value of land in this densely-peopled industrial district is one element in the costliness of the school. Others are the completeness of the design and the excellence of the work.

To give any adequate idea of the completeness of the school, we must add a word or two to say that the various buildings on the borders of the large playgrounds are special schools for blind children, for the deaf and dumb, for the mentally afflicted, and centres for laundry-work and cookery, and another to be built shortly is to provide laboratories for the teaching of chemical and physical science.

The Hugh Myddelton School is rapidly becoming one of the best-known of London Board Schools; and this is due not merely to its completeness, and to the other points on which it has seemed worth while to give some details, but to certain circumstances which have combined to invest it with special interest. First, the site itself is that of the old Clerkenwell Prison, the prison which was the scene of the terrible explosion in the latter part of 1867. Then public attention was called to the school by the fact that the ceremonial opening was made by the Prince of Wales, and, whether intentionally or not, the date of this event was December 13th, 1893, the twenty-sixth anniversary of the criminal attempt to blow up the prison.

At this ceremony His Royal Highness referred to the fact, and also to a prophetical picture in *Punch* of an earlier date, intimating that the opening of

free schools would help to empty the prisons. This displacement of a famous prison by a magnificent public school was a sort of fulfilment of the prophecy.

Some of the old cells of the prison are preserved intact beneath the present building as a kind of gruesome antiquarian adjunct to the school museum. To make ourselves fully acquainted with the school, we paid a visit with some friendly companions to this subterranean domain, and after groping our way along dim passages, we came to the cells where notorious criminals had been detained. From these depressing caverns of darkness and despair it was a welcome change to come back to the hopeful halls, with their promise of light and life to thousands of English boys and girls.

The name of this school adds further to its interest, for it commemorates that enterprising Englishman who founded the New River Company for supplying London with water, the terminus of the undertaking being in the neighbourhood.

Again, the halls of the Hugh Myddelton School have been used for the last two or three annual exhibitions of drawings, needlework, and other handiwork done in the schools of the Board. Hence they have become known to many visitors from all parts of London, and from other cities of our own and other lands. In the Visitors' Books of the school appear the names of Visitors from Berlin, Darmstadt, St. Petersburg, Colorado, California, Newfoundland, New York, Rio Janeiro, and many other places.

The foregoing particulars we have gleaned from various documents and from several visits; but, after all, the real life of a school depends on the teacher who rules and guides it, and to know more of that we should make the acquaintance of the Head Master.

We find him at his post ready with hearty words of welcome, and willing to give any information which may be interesting or useful.

Mr. Ellson's work as a teacher has not been limited to that done in his present noble school during the last two years. This will be obvious from the following biographical notes, which we have been able to compile from several memoranda.

Mr. Joseph E. Ellson was born in Leicestershire in December 1852, the son of a farmer. He served as pupil teacher in Woodford National School, Northamptonshire, under his brother, Mr. W. P. Ellson, of whom he says, 'My brother was a first-rate master, as his unbroken record of excellent reports for 25 years goes to show. *Method, intelligence, thoroughness*, characterised all his work. I was fortunate in being trained by him, and I owe him much.'

At the end of his apprenticeship our friend proceeded with a first-class Queen's Scholarship to Peterborough Training College. After a successful course of two years there, he came out, at Christmas 1874, at the head of the College list, and in the First Division at the Certificate Examination. At once he entered the service of the London School Board, as Assistant at Nichol Street, Shoreditch, which he considers was at that time about the *lowest* school under the Board. In six months he was transferred to Monnow Road, then under the able management of Mr. Lumley. It is pleasant to hear Mr. Ellson speak of his former chief (now, alas, passed away), in terms of hearty praise for his thorough and conscientious work, and especially for his unfailing friendship towards his assistants. His school Mr. Ellson believes was then the *best* of the Board Schools, and certainly, to judge from printed records, there seems good warrant for his belief. A report for the year 1877 states that in the percentage of prizes and certificates in the Scripture Examination, in the number of Drawing prizes obtained, and in the percentage of passes in the Government Examination, the Boys' Department of Monnow Road School occupied the *First* position among the 211 similar departments then under the Board. In the latter part of this year, 1877, Mr. Ellson was promoted to be Head Master of Hart Street School, Covent Garden. He is somewhat proud of the distinction of being the first Assistant to become the head of a London Board School from a school which has since supplied so many head teachers in its service.

When Mr. Ellson took charge of Hart Street School it was in a backward state. Two years later, in 1879, Mr. Matthew Arnold, H.M. Inspector, reported thus: 'The results of the examination are most creditable to Mr. Ellson. In the one room the whole body of scholars has been thoroughly well taught. The Arithmetic has a soundness about it which cannot be too highly praised.'

After a few weeks at Columbia Road, Bethnal Green, Mr. Ellson was appointed to Wellington Street, Hoxton, which was in a somewhat disorganised state through recent neglect. The percentage of passes was as low as 68, and no extra subject was taken, but during the next three years the percentage rose to 96, two extra subjects were taken, the grants increased, and the Inspector reported the school two years in succession as doing 'exceedingly well.' Mr. Ellson is pleased to recall the fact that one of his pupil teachers here headed the scholarship list in 1883, and another stood No. 16 in 1885. During these years, 1883–5, Mr. Ellson was Registrar and Teacher at the Hackney Pupil Teachers' Centre Classes, then held in the evening.

In 1882 he took charge of the larger school at London Fields, a school which was also in a backward state, having received a series of eight annual reports assessed by the Board as only 'Fair.' Improvement soon showed itself, and continued for the next ten years, for the last eight of which the merit award was 'Excellent.' During this time five boys out of six sent in gained Bancroft Scholarships of £60 per year for four years, and six other scholarships were also gained.

It was with this record of excellent service that Mr. Ellson in August 1893 opened the Hugh Myddelton School for 600 boys.

'And how did the work of filling this large school proceed?' we ask, and for answer our friend says, 'Well, there was some difficulty at first, for there was no temporary boys' department from which the scholars were to be drawn, as was the case with both girls and infants. The first week I admitted only 99. Rumour said the school would never fill, and that it would be another "white elephant" of the Board. Gradually, however, the rooms were filled, a few boys coming every week. In all 1,050 boys have been admitted, 640 names are now on the roll, and the average attendance is 540.'

'By what sort of boys is the school chiefly attended?'

'At first we had a very poor class. About 100 of the well-known truants of all the schools round about were on the roll at the end of six months. But the

class of boys has improved, and is improving, though there is still a considerable migratory element, as may be inferred from the fact that while we have admitted 1,000 in two years fully 400 have left in the same time.'

'Do you mind mentioning any special incidents which indicate points of progress since your work here began?'

'Not at all. The public opening by the Prince of Wales had, of course, considerable influence in drawing attention to the school. It was rather hard, indeed very annoying, that, on this important occasion, when I had not been absent from duty on account of illness for fifteen years, I should be in bed in the grip of influenza. Last year the school was made a Higher Standard School. Two specific subjects are now taken, Shorthand and French. The class subjects are Geography and Elementary Science, the latter being made a speciality. We have had two annual examinations by Her Majesty's Inspector, and the reports have both been of excellent character, with the highest grants all round, and the same may be said of the results in Drawing. Swimming and Wood-work form part of the school work, and Typewriting is taught. Football and cricket clubs were formed soon after the opening. A violin class is now forming. The first school concert was given last Christmas, and the net proceeds, amounting to £8, were devoted to the athletic funds of the school.'

Yours faithfully
J. F. Ellson

'Your list of subjects is a pretty full one,' we remark, and Mr. Ellson replies, 'Yes, and I feel the danger of overcrowding the curriculum. Variety is indeed essential, but this can be secured without unduly multiplying the number of subjects and having none, or few of them, taught *intelligently and thoroughly*. Drawing is a subject I would not abate a jot of, rather I would increase it, at least in the lower standards.'

In the course of a walk through the class-rooms our attention was called to some very neat work in the way of designing by conventionalising from drawings made from plants and flowers—as the rose, the ivy, the Virginia creeper. This was done by a few boys under the guidance of one of the class masters who has special artistic skill. This special ability came into evidence also in the form of very carefully finished coloured chalk drawings on panels of slate, which are fixed to the walls in front of the classes for the purpose of illustrating object and science lessons.

In another class-room a teacher had been giving to boys in the third standard a lesson on the chemical reactions of oxygen on sulphur, potassium, etc., and by the use of coloured chalks he had represented these reactions in a very graphic and impressive way on the wall slates. The slates were also used for exhibiting the music of some school songs, the different parts being written in different coloured chalks. These are examples of the way in which the lessons are made attractive.

As we hear a simultaneous ringing of bells, Mr. Ellson takes us to his room and points out a kind of electrical timing machine with a dial like a clock face, and indices set at the various times for changing lessons. As these times are successively reached an electrical current is established, which communicates with all the class-rooms and rings an electric bell in each. The clocks in the class-rooms are connected with the principal clock in the hall by electric wires.

The question of attendance and punctuality being broached, our attention is directed to a neatly-designed 'punctuality chart' suspended at one end of the hall. It represents in a graphic and ingenious way the degree of punctuality reached week by week in each class, and so affords a ready means of comparison and a stimulus to improvement. Mr. Ellson describes another plan which he has found useful. The names of all late boys are entered class by class in a note-book, and this record is made the basis of warning and exhortation, and if necessary of punishment to habitual offenders. Yet another plan is the exhibition in the class-rooms of lists of boys who have attended with perfect regularity since the beginning of the school year, and therefore have a chance of obtaining a medal. The name of anyone who comes once late or who is once absent is immediately crossed off.

These various plans it may be well understood are among the results of Mr. Ellson's long and successful experience in other schools. On this point, he says,—

'I think it may be said I have had about as varied and full experience of school-teaching and schools

under the London Board, as almost any master in its service. Only the older of these know what the pioneering work was twenty years ago, and the dreadful pressure a few years later after the schools were built and were pretty full, the pressure which arose from the driving, cramming process necessary to secure the "Good" award from the Inspectors administering the earlier Codes. Upon that award so much depended—the annual increases of salary of the whole staff—and it was a common thing for the School Management Committee to lower the assessment of the Inspector from "Good" to "Fair," and from "Excellent" to "Good." This lowering was a dreaded blow, because it was felt that the award "Fair" a second time was likely to bring dismissal as a consequence. The worry and strain of to-day, great as they are in many cases, bear no comparison with the tension and terrible drive of the years 1879-1887. The present young teachers have indeed escaped much trouble. If there is one thing my varied experience in different schools has taught me, it is what at one time I would not have admitted, viz., How utterly impossible it is to accomplish in a *poor* neighbourhood the work so easily and naturally done with a good class of children.'

Here our friend admits that circumstances—buildings, appliances, are favourable, and he has good hope that what he has learnt to regard as the true aims of a schoolmaster may be to a considerable extent realised. Those aims he thus defines:—

'First, Solid, intelligent work in *all* subjects taken, rather than special excellence in some, with weakness in others. Second, Fair and honest use of the teaching powers of the staff for the good of the *whole* body of scholars, not a concentration of the best teaching on the few to the detriment of the rest, for the sake of producing some special show-work. Third, and of the highest importance, The formation of good habits—punctuality, cleanliness, industry, perseverance, self-reliance, self-control. We should teach a boy how to acquire knowledge himself rather than help him to it. In primary schools we overteach; in secondary they do not teach enough. We should train a boy how to govern himself, not simply how to be governed by others.'

Would you further tell us by what special means you endeavour to reach these aims?

'First, I have a complete syllabus for each Standard for the whole year. This is so arranged as to subdivide the work in each subject for each month.' A specimen or two of these schemes of work is appended; but it should be added that the schemes in use at present have been considerably altered to fit them to the new Code, and to the improved organization of the Upper Standards. 'I have adopted this plan with satisfactory results for some years. The teacher of each class has a considerable share in arranging the syllabus by which he will have to work, and I frequently find I have to lessen the amount of work he proposes to do in a given time.

'It is important that the *method* of teaching any subject should be *uniform*, but not slavishly uniform throughout the school. This facilitates the passage of boys from class to class, or from teacher to teacher. For example, in Grammar the same definitions and abbreviations should be used; in Writing the same form of capitals and figures at least up to Standard IV.; after that more freedom may be allowed. One advantage of this is that time and labour are saved, another is that teachers and classes feel themselves part of an organic and harmonious whole. Next I give the teachers full power and freedom in their work so long as they observe the *general* regulations and methods of teaching which are necessary for the general good of the school as a whole.

'Periodical and thorough examination of the scholars and classification after each examination I find essential. No weaknesses can then go undetected, and boys are put in the most suitable classes. The results of the examination are recorded in a book for each class, and this I find a valuable help. This plan also I have had in operation for some years. The Chief Inspector, Mr. Sharpe, was much pleased with the detailed schemes and records of progress we had in use.'

'Above all,' continues Mr. Ellson, 'a good, loyal, mutual feeling between head and class teachers is essential to the true success of a school.'

It is a great pleasure to hear our friend descant on his staff, of whom he has good reason to be proud. He says,—

'I can speak in the highest terms of my men in this respect. They render loyal service at all times for the school's welfare as a whole as well as for that of

SYLLABUS OF WORK FOR STANDARDS V.–VIII. FOR 1893-4.
DECEMBER. NOVEMBER. OCTOBER. SEPTEMBER. JULY. MAY AND JUNE.
CODE REQUIREMENTS.
To read with intelligence, fluency, Geo. Readers, to p. 36 Geo. Read. to p. 62

SYLLABUS OF WORK FOR STANDARDS V.–VIII. FOR 1893–4.

	Code Requirements.	May and June.	July.	September.	October.	November.	December.
Reading.	To read with intelligence, fluency, and expression, from Shakespeare or some standard author or History of England, a passage previously unseen	Geo. Readers, to p. 36 Hist. Readers, to p. 36 Ord. Readers, to p. 35	Geo. Read., to p. 63 Hist. Read., to p. 72 Ord. Read., to p. 67	Geo. Read., to p. 102 Hist. Read., to p. 108 Ord. Read., to p. 102	Geo. Read., to p. 143 Hist. Read., to p. 143 Ord. Read., to p. 131	Geo. Read., to p. 180 Hist. Read., to p. 182 Ord. Read., to p. 165	Geo. Read., to p. 221 Hist. Read., to p. 218 Ord. Read., to p. 200
Composition.	VI. Theme (about 20 lines) V. Short Story. Spelling, writing, and correct expression to be taken into account *or* Unseen Dictation, 10 to 12 lines (3 errors allowed)	*Note.*—Dictation made by Teacher to embrace words previously prepared; or 10-12 lines from a newspaper as a test, or the hardest words selected and spelt. Thoroughly master a few words each day from Victory book, No. 5.					
		V. Oral Composition. Story built up on B.B. VI., VII. Subjects — Coal, Wool, Silk, Ink, Chalk	V. Oral Composition. Headings only on B.B. VI., VII., Newspapers, Railways, Money, Books	V. Oral and with boys on B.B. VI., VII., Museums.	V. Boys alone with notes on B.B. VI., VII.	V. Oral. Model by Teacher, Boys afterwards on Paper VI., VII.	V. Oral. Heads only to be given, then Boys alone on Paper VI., VII.
		Copy Books. Without Headlines. Mistakes to be marked in red ink.					
Arithmetic.	V. Fractions, Add., and Sub. with denominators up to 12. Practice, Bills, Simple Proportion (Unity Method) VI. Fractions, Vulgar and Decimal, Simple Proportion, Simple Interest VII. Averages, Percentages, and Stocks	V. Simple Practice VI. Vulgar Fractions	V. Compound Practice, G.C.M. and L.C.M. VI. Vulgar and Decimal Fractions	V. Add. and Sub. of Fractions and Practice VI. Decimals and Proportion	V. Bills of Parcels and back work VI. Simple Interest	V. Proportion—Method of Unity VI. Simple Int. and back work	V. All Rules VI. All Rules
Geography.	British Colonies and Dependencies Interchange of Productions Circumstances which determine climate	Origin and Growth of Colonies Meaning of term, How acquired European Possessions— Gibraltar, Malta Asiatic Possessions— Cyprus, Aden and Perim, Socotra, Kuria Muria, India—Physical	India—Political Ceylon Straits Settlement Labuan Sarawak Hong Kong Cowloon Islands in Indian Ocean	African Possessions Page 18–33 Gill's Atlas Geo.	North American South American and Central do. Possess.	West Indies Australasia New Zealand	Causes which affect Climate Interchange of Productions Recapitulation
Ele. Sci.	Outline of Physiology and its bearing on health and work	General build of body, Bones of body, Division of body and Contents of Head, Thorax, Abdomen	Heart and Blood-vessels Blood and Circulation	Organs of Digestion Foods and changes undergone in digestion	Respiration Changes in blood caused by above Removal of waste from the body	Skin, Kidneys, and Recapitulation of back work	Exercise of Body and Mind Fresh Air, Food, diet needed Cleanliness Improper and Proper Postures
Eng.	Merchant of Venice V. (100 lines) } with meanings VI., VII. (150 lines) } and allusions	General explanation Reading whole through Sketch of author's life	25 lines and explanation	25 lines and explanation	25 lines and explanation	25 lines and explanation	Recapitulation
Mes. Arith.	To promote dexterity, quickness, and accuracy. Deal with concrete and abstract quantities. Object—To prepare for work of next standard and to anticipate the longer problems	Tots, 10 lines Macnamara's book V. Page 6–17 (as a basis)	Tots, 12 lines 18–27 St. V.	Tots, 14 lines 22–36 St. V.	Tots, 15 lines 36–44 St. V.	Tots, 16 lines 1–14 St. VI.	Tots, 17 lines 14–28 St. VI.
		Give copious examples in Add., Sub., Mult., and Div. Rapid tables, both money and weights and measures. Insist on quick mental work.					
Music.	See instructions to H.M. Inspectors —page 38. N.B.—Combined Time and Tune Test	Ed. Chart. No. 3, 4, 5, 7 Code Sing Tests P. 21 (1–6) P. 26 (1) P. 29 (1–20) Song	1, 2, 10, 12, 13 to 18 P. 21 (7–10) P. 24 (1–3) P. 26 (2–4) P. 29 (21–40) Song	29, 34, 35, 6, 8, 9, 11, 29 to 25 P. 22 (1–6) P. 24 (4–6) P. 26 (5–6) P. 29 (41–60) Song	4, 5, 47, 48, 30 to 33, & 26 to 28 P. 22 (7–12) P. 24 (7–10) P. 27 (1–4) P. 30 (61–80) Song	49, 50, 51, 44, 46, 36 to 40 P. 24 (1–4) P. 24 (11–13) P. 27 (5–8) P. 30 (81–100) Song	41 to 43, 52, 53 P. 28. The whole Paper P. 31 (101–114) Songs
Shthand.	To write at least 30 words per minute from unseen book equivalent to a second reader, and to write separate words and phrases	Finish Grade I. (Script) by the end o July.		Finish Grade II. (Script) by the end of December, and give plenty of practice in writing words, phrases, and sentences.			
Drawing.	All Standard V. work. Freehand. Model, Easy Rectangular and Circular, and easy common objects Geometry—Perpendicular and Parallel lines, Division of lines, Square and any kind of Triangle, Construct and bisect angles	Freehand—Curves, and Designs from Curves Model—Cube and Oblong Geometry—Bisect line and curves, and erect Perpendiculars	Freehand — Combination of curves and straight lines Model—Hexagonal Prism Geometry—Parallel lines and squares and oblongs	Freehand. Copies on B.B. Model—Cylinder in any position Geometry—Division of lines, Equi., Isos., and Scalene Triangles	Class to follow Teacher line by line from and B.B. Adapt copies where possible to designs. Model—Combination of any two of the foregoing objects Geometry—Bisect and Trisect any angles	Model—Any common object in school Geometry—Construct triangles with any given angles	Recapitulation
Drill.	As per Board Syllabus [Enter the exercises done month by month]						

* The scheme now in use varies greatly from this, Standards VI., VII forming a separate class.

GRADUATED SCHEME OF WORK FOR STANDARD I_A FOR YEAR 1894-5.

Code Requirements.	Subject.	May and June.	July.	September.	October.	November.	December.	Jan., Feb., Mar.
To read a short passage from a book, not confined to words of one syllable	Reading	To p. 35, Arnolds' R. To p. 35, Chambers' R. Punctuation Simultaneous Work	To p. 50, Arnolds' R. To p. 50, Chambers' R. Easy Phrasing Individual Work	To p. 65, Arnolds' R. To p. 65, Chambers' R. The Aspirate Questions on Matter	To p. 80, Arnolds' R. To p. 80, Chambers' R. Easy Endings Simple Meanings	To p. 95, Arnolds' R. To p. 95, Chambers' R. Easy expression Recapitulation	To end of Book To end of Book Recapitulation Recapitulation	Recapitulation Examination
Copy in manuscript characters, a line of print, commencing with a capital letter. Copy Books	Writing	Formation of Letters, cap. and small Transcription of Letters C.B.—Lessons on holding pen. Up and down strokes. (Paper.)	More difficult Letters Trans. of Words C.B.—Combination of hooks and hangers. *i i i n* Word Bldg., *a* { with Consts.	Lessons in Joining Trans. of Sentence C.B.—Letters with *e* in them: *a*, *g*, *d*, etc., *e*, with Consonants	Copies from B.B. Transn. from R. Book C.B. — More difficult letters, *k*, *f*, *q*, *r*, *x*, etc., *i* with Consonants	More difficult copies Transcription C.B.—2 letters joined *o*, with Consonants	Recapitulation Recapitulation C.B.—Capitals and figs. *u*, with Consonants	Recapitulation Examination
Notation and Numeration to 1,000 Simple Addition and Subtraction. Not more than 3 figures. In Addition not more than 5 lines. To 6 times table	Arithmetic	Mental Addn. to 30. Copy figures from B.B. Not. and Numn. to 100. Easy Addn. of Tens and Units. Application to Concrete quantities. Neat work	Mental Subtn. to 30 Notn. and Numn. to 999 Addn. of Hundreds Applicn. to Concrete Quantities	Mental Addn. and Subn. to 40 Notn. and Numern. Problems in Addition	Recapitulation Recapitulation Recapitulation Subn. (without borrowing) (application)	Recapitulation Subtraction, borrowing Signs: +, −, ~, and Terms: plus, total, sum, difference, etc.	Add. & Sub. Problems Not. & Num. to 9999 Neatness Recapitulation	Recapitulation Examination
		Mental Work for first 10 minutes in each Lesson.						
Not to involve large numbers. Deal with concrete and abstract quantities. Preparation to Stand. II. To promote dexterity, quickness, and intelligence. To anticipate longer problems	Mental Arithmetic	Easy Addn. and Subn. 20 12 Twice Times Table, with application Mentl. Notn. and Num. as above	Addn. and Subn. to 30 3 Times Tables with Problems Do. Do.	Money Problems to 6d. 4 Times Table, with Problems Lessons on ½s. and ¼s.	Money Problems to 1s. 5 Times Table with appn. Chats on Weights	Money Probs. to 1s. 6d. 6 Times Table, with Problems Chats on Length	Money Problems to 2s. Tables daily with appn. Chats on Time	Recapitulation Examination
Plan of School and Playground. Four Cardinal Points. Meaning and use of a Map	Geography	Home Geography Chats on City, Town, Country, and also Seaside Neighbourhood	Recapitulation The Four Cardinal Points	Mariners' Compass, Weathercocks, Winds, etc., application of 4 Card. Pts. to School	Plan: Definition of and Drawing to Scale of Com. Objects, 8 Card. Points	Recapitulation, with Plan of Classroom	Recapitulation Plan of School and Playground. Maps of district, London, & England	Recapitulation Examination
Paul Bert to p. 44 (as a basis). Examination based on Teacher's Notes	Elementary Science	Class into 3 Kingdoms: Vertebrates & Inverts., Quadrupeds, Bipeds, Mammals, Insects, etc. Terms explained	Mammals: Man, Monkey, Bat, and Insect-eating Animals	Recapitulation Flesh-eating Mammals	Recapitulation Herb-gnawers and Cud-chewing Mammals	Recapitulation Horned Ruminants, Elephants, Cud-chewing Mammals	Recapitulation Pigs, Mammals, Whale, Porpoise, etc. to end	Recapitulation Examination
The examination will be based on the Teacher's Note Book	Object Lessons	Cat, Dog, and Goat, Clay, Slate, Sand, Sugar, Oak, Water	Tiger, Elephant, India-rubber, Cork	Table Salt, Quill, India-rubber, Cork, Bat, Mouse	Claws and Paws, Down, Spider-threads, Apple, Daisy, Milk, Hare	Edible Birds, Ass, Building a House, Butterfly and its forms, Bronze Coins, Whalebone	Ant, Coffee, Cocoa-nut, Cotton and Wool, Umbrella, Roots as Food, Onion, Turnip, Carrot	Recapitulation Examination
Rectangular figures with and without rulers. (*See* Note Book for collection of figures drawn)	Drawing	*Lines*—Definitions of, Freehand and Rulers, Use & explan. of Ruler. Learn to sketch	*Angles*—Definitions of Freehand and with Rulers	Divisions of Lines and Angles into 2, 3, 4, 6, 8, etc. Freehand and Rulers	The *Square*—Definitns. diagonals and division into parts Do. Do.	The *Oblong*—Definitn., various divisions Do. Do.	Figures formed from Oblong and Square, Definitions Do. do.	Recapitulation Examination
Instruction to H.M.I. p. 38. The Doh Chord and Notes in stepwise succession: 2, 3, and 4 Pulse Measure	Music	Doh Chord (Chart to Ex. 12) Code Singing Tests Song	Notes in stepwise succession Chart. to Ex. 20 2-Pulse Measure, Song	Recapitulation with Ex. on Easy Thirds Chart. to 30 3-Pulse Measure, Song	Imitating Sounds, with names of Notes, 4-Pulse Measure, Song, Recapitulation	Length of Notes, taa, taa-tai, taa-a, etc. Time, Rests, Song	Easy Expression, Chart Work, Code Singing Tests, Time, Song	Recapitulation Examination
The Miller of the Dee	Repetition	Chats on the Matter and General Explanation	1st verse Spell, repeat, and learn by heart (meanings)	2nd Verse Do. Do. Do.	3rd Verse Do. Do. Do.	Recapitulation (especially meanings)	Recapitulation Do. Do. Do.	Recapitulation Examination
As per Board Syllabus [Enter the exercises month by month as they are done]	Drill - -							

Lessons on:—Obedience, Punctuality, Regularity, Cleanliness, Honesty, Truth, Kindness, Idleness, Concentration, Neatness in Work, Thrift, Speaking Properly, Good Manners, Unselfishness, &c., &c., last ½ hour, Friday afternoons.

MORNING. AFTERNOON.

—	Standd.	8.45—9.	9—9.15	9.15—9.45	9.45—9.55	9.55—10.	9.45—10.25.	10.25—10.35	10.35—11.5.	11.5—11.15.	10.35—11.15.	11.15—12.	1.45—2.	2—2.15.	2.10—2.15.	2.15—2.55.	2.55—3.5.	2.55—3.35.	3.35—3.45.	3.5—3.45.	3.45—4.30.	4.30.
	VII. &						Reading		Geography		—	Arithmetic				Mental Arithm.						

TIME-TABLE FOR SCHOOL (BOYS).

ARRANGED BY MR. ARTHUR PATTERSON.

STUDENT.

—	Standard.	9.45—10.25.	10.25—11.5.	11.15—12.	2.15—2.55.	2.55—3.35.	3.5—3.45.	3.45—4.30.
		Assemble in Playground—Drill—March to Class-rooms.						
		First Roll—Hymn and Prayers in Hall.						
		Religious Instruction.						
		Second Roll.						
MONDAY.	VII. & Ex. VII.	Reading	Geography	Arithmetic	Mental Arithme-tic (to 2.45) and Recitation	Composition	—	Drill or Arithmetic
	VI.	Reading	Geography	Arithmetic	Recitation	Composition	—	Drill or Arithmetic
	V.	Reading	Geography	Arithmetic	Recitation	Dictation	—	Read. or Arithmic.
	IV.	Reading	Geography	Arithmetic	Recitation	Dictation	—	Music
	III.	Reading	—	Arithmetic	Recitation	—	Word Building and Writing	Music
	II.	Reading	—	Geography	Recitation	—	Writing & Music	Reading
	I.	Woodwork—20 Boys from Standards VII. and Ex. VII. (9—12).			Woodwork—20 Boys from Standard VI. (2—4.30).			
TUESDAY.	VII.	Arithmetic	Composition	Shorthand	Elemen. Science	Read. or Arithmic.	—	Drawing
	VI.	Arithmetic	Composition	Shorthand	Elemen. Science	Read. or Arithmic.	—	Drawing
	V.	Arithmetic	Composition	Shorthand	Elemen. Science	Composition	—	Drawing
	IV.	Arithmetic	Reading	Dictation	Elemen. Science	Reading	—	Drawing
	III.	Arithmetic	Reading	Dictation	Object Lesson	Copy Books	—	Drawing
	II.	Arithmetic	—	Dictation	Object Lesson	—	Reading	Drawing
	I.	Reading	—	Dictation	Object Lesson	—	Reading	Drawing
		Recreation, I. and II.			Recreation, III. to Ex. VII.			
WEDNESDAY.	VII.	Reading	Dictation	Arithmetic	Geography	Composition	—	Music
	VI.	Reading	Dictation	Arithmetic	Geography	Composition	—	Music
	V.	Reading	Dictation	Arithmetic	Geography	Composition	—	Music
	IV.	Reading	Dictation	Arithmetic	Geography	Object Lesson (to 3.25)	—	Arithmetic
	III.	Reading	Dictation	Arithmetic	Geography	Mental Arithmtc.	—	Drill or Reading
	II.	Reading	—	Arithmetic	Geography	Mental Arithmtc.	—	Dictation
	I.	Reading	—	Arithmetic	Reading or Drill	—	Object. Less. (to 3.35 & Men. Arth.)	Writing
		Recreation, III. to Ex. VII.			Swimming—60 Boys from Standards V. to Ex. VII. (3.45—4.30).			
THURSDAY.	VII.	Arithmetic	Shorthand	Drawing	Composition	French	—	Reading
	VI.	Arithmetic	Shorthand	Drawing	Composition	French	—	Reading
	V.	Arithmetic	Shorthand	Drawing	Drill or Arithmtc.	French	—	Reading
	IV.	Arithmetic	Read'g. or Recitn.	Drawing	Elemen. Science	Dictation	—	Reading
	III.	Arithmetic	Word Building or Writing	Drawing	Object Lesson	Dictation	—	Reading
	II.	Arithmetic	—	Drawing	Object Lesson	—	Mental Arith. & Music to 3.35	Drill or Dictation
	I.	Arithmetic	—	Drawing	Object Lesson	—	Writing	Music
		Recreation, I. and II.			Woodwork—20 Boys from Standard V. (2—4.30).			
FRIDAY.	VII.	Read'g. or Recitn.	Elemen. Science	Arithmetic	Maps or Geogry.	Reading	—	Cpy. Bks. or Comp.
	VI.	Read'g. or Recitn.	Elemen. Science	Arithmetic	Maps or Geogry.	Reading	—	Cpy. Bks. or Comp.
	V.	Read'g. or Recitn.	Elemen. Science	Arithmetic	Maps or Geogry.	Reading	—	Cpy. Bks. or Comp.
	IV.	Drill or Reading	Dictation	Arithmetic	Maps or Geogry.	Reading	—	Cpy. Bks. or Dicty.
	III.	Reading	Dictation	Arithmetic	Varied Occupns.	Reading	—	Cpy. Bks. or Dicty.
	II.	Reading	—	Arithmetic	Varied Occupns.	—	Reading	Copy Books
	I.	Reading	—	Arithmetic	Mental Arithmtc. & Word Bldng.	—	Varied Occupns.	Copy Books
		Hymn and Prayers in Hall—Dismissal.						

Special.—VII. & Ex. VII. 4.30 to 5 p.m.

	M.	T.	W.	Th.	F.
	French	Shorthand	Algebra	French	Shorthand

Standard.	Reading.	Writing.	Arithmetic.	Men. Arith.	Geo. & Maps.	Ele. Science.	Obj. Less.	Drawing.	Shorthand.	French.	Music.	Recitation.	Copy Books.	Drill.	Var. Occup.
VII. & Ex. VII.	3.25	3.42	4.17	.30	2.0	1.20	—	1.30	1.25	.40	.45	.30	.23	.23	—
VI.	3.25	3.42	4.17	.30	2.0	1.20	—	1.30	1.25	.40	.45	.30	.23	1.23	—
V.	3.28	5.42	4.17	.30	2.0	1.20	—	1.30	1.25	.40	.45	.30	.23	.20	—
IV.	4.45	3.48	4.20	.40	2.0	1.20	.30	1.30	—	—	.45	.30	.22	1.02	—
III.	4.27	4.28	3.35	.40	1.20	—	1.50	1.30	—	—	.45	.10	1.02	.23	.40
II.	4.40	3.52	3.35	1.10	1.20	—	1.50	1.30	—	—	.55	.10	.45	.23	.40
I.	5.05	3.30	3.35	2.0	1.20	—	1.50	1.30	—	—	2.05	.10	.45	.20	.40

their own particular class. My thanks are due to the managers and to the Board for the nearly free hand I have been allowed in selecting my own men. I am well aware how much the success of the school in the future depends upon the hearty exertion of each member of the staff, and this being so, I am happy to say the outlook for the school is so encouraging.' Then Mr. Ellson proceeds to name almost everyone of his men as contributing in some special way to the character of the school. 'Mr. Hodges is a specialist in singing. He trains the boys for the concert, and under him the singing promises to become a feature. I strongly believe in the educative influence of music in a school; it acts and re-acts on all the work. Certainly it affects discipline, for without good discipline we cannot get excellent music. The Art side is developing well under Mr. Gerard, and two or three other teachers. Elementary science bids fair to come to the front, for four men are strong in it. It is thus remarkably well taught, and illustrated with experiments and sketches. The boys like it immensely.' A specimen of the object lesson and science schemes in use is appended, through the kindness of Mr. Ellson, who has placed a number of such documents at our disposal.

One of the teachers, we learn, manages the Football Club, one or two others the Cricket Club, another the Museum and Magic Lantern, another the Library, another the Science Apparatus, and yet another the Violin Class; while Mr. Richards renders special help as First Assistant. At this point we may mention that Mr. Ellson refers with much satisfaction to the number of his former assistants who have become head masters, and now hold important posts, five under the London Board and two elsewhere.

On the walls of the Hall we observe some good engravings and etchings, among them a pastoral scene representing Isaac Walton, a fine etching of Westminster Abbey, and some striking figure subjects. On these, Mr. Ellson remarks, 'At about the time when I began work here, a job lot of special pictures had been bought by the Board, and I was fortunate enough to have the first choice. Good pictures are in my opinion wonderfully potent for good. On many boys they have of themselves a great influence, and when taught and explained, they have an elevating influence on all. In connection with "varied occupations" they can be turned to excellent use.'

'Have you anything to say about Drill?'

'I certainly recognise its importance. The physical side of education, so generally neglected when the craze for cramming held sway a few years ago, is now happily receiving more attention. Military discipline I do not advocate, but I hold that it is difficult to over-estimate the good effect of the syllabus of drill and exercises laid down by the Board when worked out intelligently and fairly. Heated competitions as a means of promoting education in any direction, I entirely condemn.'

'What is your opinion of the new system of intermittent inspection?'

'If it is administered in a true educational spirit, the coming change will be welcomed by the earnest, conscientious and real teacher. He will have confidence in his own powers and his integrity, and will have a chance of producing "results" differing from those formerly produced, but none the less patent to the expert eye, and far more abiding. The only fear is lest some of the inspectors may fail to do their work in this spirit, and may rather pay their casual visits as the check inspectors step on to the tramcar as simply agents of suspicion.'

It would hardly be fair to the subject of this sketch to ignore Mr. Ellson's professional activity outside his school on behalf of his fellow teachers. He has been an active member of the National Union of Teachers for twenty years, has served for ten or twelve years on the Committee of the Hackney Association, and filled the offices of its President and Treasurer, and representative at several conferences. He says: 'I firmly believe in *one* strong Union of Teachers, established and worked on *professional lines*.' He has also been a Member of the Orphanage Councils. He has been connected with the Metropolitan Board Teachers' Association for twenty years, and is this year President of the L.S.B. Head Teachers' Association. In the latter capacity he gave an able address last January, dealing specially with the new developments in educational matters, and with the need for

unification of our national system, by the organisation of a scheme of secondary education, and its co-ordination with the primary.

Mr. Ellson is ex-Chairman and a Vice-President of the Peterborough College Club, in the resuscitation of which a few years ago he took special interest.

Before leaving the school we were privileged to see the whole of the boys, numbering over 500, assembled in the Hall for singing and prayer. The singing of one or two hymns in harmony was very pleasing, and was followed by a reverent repetiton of the Lord's Prayer and one or two others. The extremely quiet and orderly marching of the various classes, first to their cap-rooms and then down the stairs, concluded an impressive scene.

As our visit comes to an end we feel that we have learnt much from the handsome Hugh Myddelton School and its energetic master. The latter impresses us as a man who takes a serious view of his professional work, a man with clear and high aims, and definite views as to the means of realising them. By the steady application of well-chosen methods, and of well-directed energy, he seems likely to secure for Hugh Myddelton School a succcss commensurate with its excellent plan, appearance, and material features. We can only hope that we have in some measure interested our readers in the work in which he is engaged.

LIST OF OBJECT LESSONS.

STANDARD III.

1895–6.

I.—Biological.

(*a*) *Animal.*

1. *Vertebrates.* — *Mammalia :* Monkey, bat.
Birds : Eagle, owl.
Reptiles : Crocodile, serpents.
Amphibians : Frog, newt.
Fishes : Salmon, shark.

2. *Invertebrates.*—*Insects :* Bee, butterfly.
Spiders : Garden and trap-door spiders.

(*b*) *Vegetable.*

Parts of plants.
Parts of flowers (phanerogams).
The potato (underground stem).
The onion (leaves eaten).
The turnip (root eaten).
The rhubarb (stalk eaten).
The tomato (fruit eaten).

II.—Chemical.

Oxygen, hydrogen, nitrogen, carbonic acid gas, chlorine—chemical affinity, elements, compounds.

III.—Geological.

A piece of granite.
Sand.
Clay.
Chalk and limestone.
A well in London (sections).
Underground London (sections).

IV.—Physical.

Water and its states.
How the kettle boils (convection).
A hot poker (conduction).
Hail and snow.
Vapour, steam, cloud, mist, and fog.

STANDARD IV.

I.—*Lessons from Heat.*

Effect of heat on bodies generally—solids, liquids, gases.
Expansion and contraction of solids—experiments—application in artizan work.
Liquefaction of solids by heat—expansion and contraction of liquids.
Effects produced by converting ice to steam and vice versa.
How we measure heat—thermometer.

II. — *Lessons from Mechanics (treated simply with familiar illustrations).*

Extreme divisibility of matter, molecules, cohesion—explanation of these conditions of matter, solids, liquids, gases.
Adhesion, capillary attraction—candlewick, etc.
Solids—properties explained, hardness, weight, etc.
Buoyancy of liquids—solid bodies lose weight in liquids.
Floating bodies—iron ships float, why?
Atmosphere, weight of, presses equally in all directions.
Pressure varies with height—weight varies.
Barometer, boy's sucker, syringe—their principle explained.
Action of air pump and suction pump to be explained.
Syphon principle explained—practical uses.
Pendulum.

III.—*Miscellaneous.*

Candle flame, what burns? Gas, how made from solid fat? Ventilation, why necessary? Modes of ventilation. Magnets.

MODERN EDUCATIONAL REFORMERS.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),
Author of 'Mental Science and Logic for Teachers.' Late Director of the Birkbeck Training Classes and Lecturer therein on School Method.

No. XXI.—HORACE MANN.

THE student of literature is constantly being reminded of the poverty of the United States of America in his department of study. Literary activity in the States mainly vents itself in the production of the peculiar American newspaper, which is perhaps everything save literary. There is one department, however, in which our cousins excel, to wit, that which deals with the history and philosophy of education. The energy and perseverance, to say nothing of the skill and intelligence, which have been evidenced in the many monumental works on how and what to teach, as well as on the history of the despised art, are enough to bring a blush to our cheeks when our meagre accomplishments in this direction are acknowledged. To no man is more credit for this laudable activity due than to Horace Mann, who, undaunted by coldness, opposition, and failure, steadily pursued his efforts to build up a national system of education worthy of the great nation of which he was such an ornament.

If we ask how it was that this man, to whom all careers were opened and for whom success was assured, elected to spend his life in the lowly and fame-denying pursuit of efficient popular education, we shall find that, like Froebel, he seemed born with an instinctive yearning for this species of work, and never was he happy or even content until his hand was put to the school plough, to be withdrawn only when stiffened in death.

His childhood was unhappy, and his opportunities for mental improvement few, which perhaps accounts for his resolve to put all other children in happier case. How highly he esteemed education may be gathered from the following eloquent words to which he once gave utterance: 'If ever there was a cause, if ever there can be a cause, worthy to be upheld by all of toil and sacrifice that the human heart can endure, it is the cause of education. It has intrinsic and indestructible merits. It holds the welfare of mankind in its embrace as the protecting arms of a mother hold her infant in her bosom.'

Horace Mann was born at Franklin, Massachusetts, on the 4th of May 1796. His father, whose death occurred when Horace was only 13, was a farmer. Brought up in an atmosphere of strictest Calvinism, the mind of the boy was enshrouded in gloomy fore-

bodings, which were in nowise alleviated by the hard toil, commencing at early dawn and continued till late night, day in and day out, which was his portion for many weary years. Little in quantity and poor in quality was the education which, in most erratic style, was snatched in the rare intervals of leisure. Never did Mann cease to bemoan his unhappy fate at this juncture. 'How much obstruction was thrust in between us and Nature's teaching,' he lamented. 'Our eyes were never trained to distinguish forms and colours. Our ears were strangers to music. So far from being taught the art of drawing, which is a beautiful language in itself, I well remember that, when the impulse to express in pictures what I could not express in words was so strong that, as Cowper says, it tingled down to my fingers, then my knuckles were rapped with the heavy ruler of the teacher, so that an artificial tingling soon drove away the natural.'

Notwithstanding the distressing gloom of his early training, which left its indelible mark upon him in the shape of a proneness to melancholy throughout his life, he was ever a most tender and loving son, whose unscathing condemnation of the pernicious system of which he was a victim did not blind his eyes to the fact that those who put him at the mercy of the system were animated with the firm belief that in so doing they were encompassing his salvation, both temporal and eternal.

At last came a gleam of light, when he was privileged to take advantage of the teaching of a ripe classical scholar who came to Franklin, and shortly afterwards (1816) it was made possible for him to enter at Brown's University, Providence, wherein he soon shone as a brilliant scholar. In turn he became classical master at Providence, but in 1821 he took to the law, and entered upon an honourable and fairly profitable career as an advocate. His hold upon his fellow citizens was so great, that he was elected to the Legislative Assembly of Massachusetts in 1827, and six years later to the Senate of the same State. In 1836 he became President of the Massachusetts Senate, and all things pointed to a distinguished legislative and forensic career for Mann, when suddenly, in 1836, he turned his back on all his brilliant prospects, and became Secretary of the newly-created Board of Education just established in his native State of Massachusetts.

This 'eccentric disinterestedness' is worthy of all praise. Even in our time, when despised education is beginning to loom into importance, a man would be thought mad who should give up such a position as Horace Mann had gained to become the apostle of popular education. It required a mind hundreds of years in advance of the times to see that he 'could not find a nobler station. Government had no nobler to give.' Such a mind was that of Dr. Channing, himself an enthusiastic and enlightened education-lover, who seconded the efforts of Mann in a manner gratifying to the Secretary.

What was the condition of schools and of teaching when Mann took office? 'Apathy in the people, incapacity in the teachers, dilapidation in the schoolhouses, irregular attendance in the children, the absence of all system in the mode of teaching and of uniformity in the books used; with the desertion of the common schools by the rich, in order to avoid that deterioration of manners and morals by which too many of them are characterised.'

To clean this Augean stable was the object of the devoted labours of Mann. Sixteen hours per diem were the working hours of the zealous Secretary; nearly all of his salary was expended on the good work, and more was begged by the importunate reformer, who wearied not day nor night in his efforts to promote the good of his schools.

By frequent conferences with the teachers he endeavoured to infuse a portion of his zeal into their work, and a modicum of his enlightenment into their methods.

His 'Common School Journal,' the editing of which for ten years was in itself sufficient labour for an industrious man, was an instrument all powerful in his able hands in kindling the desired enthusiasm.

His Annual Reports, of which he wrote no less than twelve during his secretaryship, were admirable treatises upon school reform, the excellence of which may be guaged from the frequency of quotation therefrom even in these latter days. School architecture, school libraries, the synthetic teaching of reading, school hygiene, school singing, text-books, common school faults and suitable punishments, the training of teachers and the admission of women to the teaching profession,—these were some of the subjects touched upon in these encyclopædic reports, and it is no flattery to say that whatever he touched he adorned.

The Dead Man of the Sea who at last overcame Mann was the religious difficulty.

The schools were Godless because they abstained from sectarian teaching, albeit the 'great axioms of a Christian morality were sedulously taught,' and it was exacted that 'the teachers shall themselves be patterns of the virtues they are required to inculcate.'

No person had a higher opinion of the teacher's office than Horace Mann. 'The clergy,' he said on one occasion, 'are reformers, I admit; but, with reference to anything that grows, one right former is worth a thousand reformers.' We are not surprised to learn, therefore, that he early endeavoured to secure a proper training for the holders of the office that he deemed so worthy. No money for this purpose was forthcoming until, in 1838, Mr. Edward Dwight, of Boston, offered 10,000 dollars to the State Legislature, on condition that they should contribute a like sum. Shamed into consent, the Assembly voted the required amount, and in 1839 the first Normal Seminary was opened in the United States of America at Lexington, being followed by two others in the succeeding year.

This did not prevent the attack of the obstructives, who dogged the Secretary's path throughout the whole of his twelve years' tenure of office. It was coolly proposed to abolish Board of Education, library, and normal schools at one fell swoop! The strain upon Mann during this trying period can better be imagined than described. Still there was no relaxation of effort, and the retrogressive proposal was negatived by a majority of 66 members in the Legislative Assembly.

In 1843 the Secretary had paid a visit of six months to Europe, during which his wife complains that she could get him to give no attention to any-

thing except schools, prisons, and hospitals. Carlyle, Kay Shuttleworth, Archbishop Whately, all received him in England. Of English schools he formed a very poor opinion; but we have no space to detail his impressions, which were embodied in his 'Seventh Annual Report,' the publication of which created much interest on both sides of the Atlantic.

One pregnant anecdote may be squeezed in here. Visiting an English school, he asked the teacher if he could read! 'Summat,' was the reply of Didaskulos; 'at any rate, I keeps ahead of the children!'

Stowe's training system failed to interest him, the only feature of note being, to his mind, the discarding of emulation.

All this time, like Lancaster, Wilderspin, Stowe, and a host of other reformers, he was making 'excursions and alarums' in all parts of the country on propaganda intent. He also personally inaugurated several teachers' institutes, himself lecturing until a competent professor could be captured. Once he visited Pittsfield upon this errand, and, finding the school in a state of unpreparedness, he off coat, and the late President of the Massachusetts State Senate was hard at it sweeping and dusting. Such was his zeal.

Yet the foremost position in his State was at his command. In 1848 he was elected to Congress in the place of the famous John Quincey Adams. He at once gave up his appointment as Secretary to the Massachusetts Education Board; but let it not be thought that this indicated a falling off in enthusiasm. By no means. Our hero projected flying at higher game, his aim being the establishment of a Board of Education at Washington, to be entrusted with the control of education throughout the whole of the States, moulded on the same lines as the Board of Massachusetts. He did not live to see the realisation of this patriotic project; but his efforts were not in vain, for in 1867 the National Educational Office was an accomplished fact.

A few years later the wire-pullers offered the whilom Secretary the nomination to the Governorship of Massachusetts, the highest honour in the power of his native State to grant. He was about the same time offered the Presidency of Antioch College, Yellow Springs, Greene City, Ohio. He accepted the latter and declined the former of these offered honours!

Life at Antioch College must have been a kind of martyrdom. Unsympathetic and progress-preventing masters united with callow country wenches and equally uncultured young men, in making the President's nights and days one long vexation.

With patience, resourcefulness, and self-abnegation, reminding us vividly of Pestalozzi's Stanz experiences, Mann struggled on, but, just as the difficulties seemed to be vanishing, he was stricken down, dying on the 2nd of August, 1859. 'His zeal in the cause,' writes his wife, 'blinded him to the extent of his own physical powers, and he fell as by a mortal blow, giving his life for the good cause as ungrudgingly as he had given his energy and his means.' Truly a noble life.

His good was not interred with his bones, for in 1865 the teachers and pupils of Massachusetts raised a statue to his memory, although his most fitting monument is the system of popular education which he, more than anyone else, was responsible for.

Of Mann the temperance reformer, abolitionist, and all-round philanthropist, we say nothing, nor do we touch upon his touching devotion to his first wife, nor say aught concerning his long and devoted friendship to George Coombe. We must, however, give a few extracts from our reformer's writings, all of which have been collected and included in the very excellent life of Horace Mann by his second wife.

LAWS OF ASSOCIATION.

'The law of association of ideas is, as yet, as far from accomplishing those beneficent ends for which the Creator implanted it in the human mind as steam was on the day when the Marquis of Worcester caught the idea of its power from seeing it throw off the lid of a tea-kettle, and before Savary, Newcomen, Watt, and Fulton made it dig coal, weave cloth, grind corn, and bring all nations and continents into one small neighbourhood.'

PHYSICAL EDUCATION.

'Physical education is not only of great importance on its own account, but, in a certain sense, it seems to be invested with the additional importance of both intellectual and moral education, for although we have frequent proofs that there may be a human body without a soul, yet, under our present earthly conditions of existence, there cannot be a human soul without a body. The statue must lie prostrate without a pedestal, and in that sense the pedestal is as important as the statue.'

ORGAN DEVELOPMENT.

'How can a work at once so vast and delicate as a sympathetic development of all the faculties be possible without the deepest science in the preparation of means and exquisite skill in applying them. The infant mind grows not by accretion but through organisation. Intelligence and wisdom and virtue cannot be passed out of one mind into another, as water from a vessel. The increment comes by assimilation and not by transfusion.'

PREPARATION.

'One of the great masters of painting used to prepare and mix his own colours, lest some crudeness in the material should baffle his skill and dim the lustre and cloud the majesty of his finished work. Do we act upon this principle in regard to education?'

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of 'Scholarship School Management.'

PUPIL TEACHERS' COURSE.

SCHEME OF WORK FOR THE MONTH.

Revision of all subjects should be continued up to the Examination. The points which require attention were pointed out last month, but a final revision of the following will probably be useful:—

English.—First Year.—The definitions of the parts of speech and of the common terms used in Parsing and Analysis.

The suffixes.

The allusions in 'The Bard' and 'Ode on Eton College.'

Second Year.—The classification of the various parts of speech.

The prefixes.

The plan, scope, etc., of 'The Traveller,' a life of Goldsmith, and an analysis of his remarks on each country.

Third Year.—'The Essay on Man'—a summary of arguments.

Life of Pope and of contemporary writers.

The Syntax of Grammar. Rules for Punctuation, Figures of Speech, etc.

Arithmetic.—Definitions of all terms employed. The theory and proof of rules.

Music.—All.

Geography.—The memory maps should all be practised daily. The note book should be used for revision. The industries, towns, and governments of the countries must be thoroughly known.

History.—Dates, Lives of Chief Men, Chief Statutes passed, Battles, Treaties, and notes.

Teaching.—Revise all. Test by means of back questions.

The Examination.

A few words regarding the Examination may not be out of place, for more marks are lost by mismanagement and oversight than by ignorance.

1. Be at the appointed place in good time. Nothing is worse before an Examination than hurry.

2. Be provided with all necessary apparatus—pens, blacklead, indiarubber, round ruler, red and blue lead, and compasses. Ink is usually provided, but it may be well to take a pocket inkwell of red ink.

3. Before commencing any work be careful to fill up any forms that may be given to you. Read very carefully all instructions.

4. Select the questions you intend to answer, and mark them.

5. Divide up your time between the questions in proportion to their importance. Supposing you are allowed one hour for Geography, and that you have to do a map and two questions, the map should take about 25 minutes and the remaining time divided equally between the other two questions.

The time allotted must be rigidly adhered to. There is always a tendency to write too much about any question which is well known. Spend a couple of minutes in thinking over the answer, and allow three minutes at the end of the time for revision.

6. Endeavour to keep the whole work as clean and neat as possible. Nothing annoys an inspector more than careless and untidy work.

7. Work your hardest, and pay no attention to any other candidates.

8. Where an answer admits of it, tabulate. It saves time.

9. In Analysis, it may be found more convenient to turn the paper longways to rule the form. The columns required are—Sentence, Kind, Connecting Word, Subject, Enlargement of Subject, Predicate, Extension of Predicate, Object, and Enlargement of Object.

10. Be careful in Arithmetic to explain the working, and show the reason for each step. Answers should be placed below the sum on the right.

11. In Euclid draw large clear figures.

12. Before writing the copy, practise once on scrap paper.

13. Make your answers as clear and concise as possible. Don't guess at answers or write round them in the attempt to make the Inspector believe you know. It is waste effort.

14. Remember that Composition is judged by the general literary merit of the answers.

If these points are attended to, very few marks will be lost unnecessarily. We wish our readers every success.

TEXT BOOKS FOR 1896.

The following text books will be used in the Course for the next Examination. It may be necessary to point out that a good text book is an essential to success. Without it success is impossible.

1.—*Arithmetic.*

Girls.—'Girls' Arithmetic,' Dixon and Beach. (Joseph Hughes and Co.)

Boys.—Lock's Arithmetic (Macmillan and Co.).

The work from these books will be supplemented by extra methods of solution, test papers, etc.

2.—*English.*

Dr. Beach's English Grammar (Joseph Hughes and Co.); *or* Canon Daniel's Grammar (National Society); *or* Mason's Grammar (G. Bell and Sons); *or* Dr. Smith's English Grammar (Murray and Sons).

For English Literature, 'Primer of English Literature' (Macmillan); *or* Cassell's 'Story of English Literature' (Cassell and Co.).

The special English Books for next year's Examination are not yet announced.

3.—*Music.*

Stanton's 'Pupil Teachers' Notes,' 4d. (Curwen and Son), is ample for the Tonic Sol Fa. Those who want a larger book should obtain the 'School Music Teacher,' published by the same publishers.

For practical work there is no better book than 'Practical Music for Pupil Teachers,' 6d. (Curwen and Sons).

For songs, Messrs. Novello and Co. publish a splendid collection in 16 books at 6d. each.

4.—*Spelling.*

The two little books (1d. each), 'Words Commonly Misspelt,' each containing a thousand catchy words, should be obtained.

5.—*Geography.*

Brook's 'Geography' (J. Hughes and Co.), *or* Meiklejohn's 'Comparative Geography' (A. M. Holden). For Europe specially, 'Europe,' by W. G. Baker (Blackie and Sons), is an excellent book, and Messrs. Macmillan publish a very complete text book on India.

A good atlas is indispensable.

Gill's 'Atlas Geography of Europe' will be found very useful as a basis.

6.—*History.*

Any of the well-known text books will suffice—Ross, Meiklejohn, Royal, or Boyd and Carpenter's: but Messrs. Macmillan are preparing a special history of the period, which will be shortly issued.

There are many very handy Analyses and Date Books published. Tait's 'Analysis' (Macmillan), Sanderson's (Blackie), or Will's 'Synopsis' (Blackie) are all reliable and useful.

I should, however, advise Pupil Teachers to wait for Macmillan's new book.

7.—*Euclid.*

Todhunter, Potts, Laing, or any standard book.

For deductions, Egan's will be found very useful.

8.—*Algebra.*

Thompson's 'Scholarship Algebra' (J. Hughes and Co.) is by far the best book to use. It is especially written for Pupil Teachers and Scholarship Students, and is just the book for those who cannot attend classes where their difficulties are explained.

9.—*Teaching.*

Flux's 'Scholarship School Management' (J. Hughes and Co.).

In addition to these books, all students should consult any authorities, articles, or papers bearing on their work. The Standard Readers in Geography, Books of Travel in Europe and Asia, Historical Readers, Historical Novels (*e.g.* 'Last of the Barons,' 'Kenilworth,' 'Westward Ho,' 'In the Golden Days,' etc.), should always be utilised, the object being to obtain as wide a view of a subject as is possible. One of the gravest defects in the education of Pupil Teachers is the limiting of their reading to what is demanded by Schedule V. General reading is a most important factor, and one that cannot with impunity be neglected. Besides giving a wide range of useful knowledge, it is of enormous assistance to the composition. Reading good books gives rise to thought, and thought brings a power of expression not otherwise attained. Letters are frequently received asking by what means composition can be improved. There is only one answer—By the careful reading and study of the works of good writers: Addison's 'Essays,' Lamb's 'Essays of Elia,' Macaulay's Essays and Reviews,' Emerson's Essays, and any of our standard writers, the number of whose works is Legion.

In addition to the ordinary subjects, all Pupil Teachers should study at least one language (French for preference) and Drawing (Freehand, Model, Light and Shade, and Geometrical drawing), and one or more Sciences. The science which should be taken first is Physiography. With this somewhat formidable list of studies must be coupled systematic and regular physical exercise, without which health would soon fail.

Remember the only way to success and eminence is regular and steady work. No sudden bursts or starts, no cram, but a steady march forward, which is delayed or turned aside by nothing.

Space forbids saying as much as might with advantage be said each month to students, but if they will send up their difficulties or doubts, every endeavour will be made to give all possible assistance, and any suggestions by which this course can be rendered more efficacious and really helpful will be thankfully received.

WORK TO BE PREPARED.

A.—*English.*

First Year.

1. The definitions of the Parts of Speech, and the derivation of the terms.

2. The Anglo-Saxon noun suffixes: *-ard, -art, -craft, -dom, -el, -le, -en, -er, -ar, -or, -yer, -hood, -head, -ing, -lin, -ling, -kind, -ness, -ock, -red, -vic, -ry, -ship, -scape, -stead, -ster, -der, -wright, -ward.*

3. Analysis of Simple Sentences, and definitions of terms employed.

4. Learn ten Roots and meanings per week.

Second Year.

1. The Noun. Classification, Number, Person, Gender, and Case.

Chief points :—

Number :—Nouns with no plural, no singular, double plurals.
Rules for formation of Plural.

Gender :—Rules for forming Feminine.
Irregular Feminines.

Case :—Note carefully Nominative of Address, Nominative Absolute, Objective Absolute, Direct and Indirect Objects, Cognate, Factitive, and Adverbial Objects.

2. One quarter of the Latin Prefixes.

3. Learn 15 Roots and meanings each week.

Third Year.

1. The English language, and how it has been formed. Anglo-Saxon literature to 1066.

2. Learn 20 Roots and meanings each week.

(*N.B.*—Until the special books for each year are announced, it will be well to push ahead with the Grammar. Ample time will then be left for the full preparation of the specified works.)

B.—*Arithmetic.*

First Year (*Boys*).

Lock : work Examples XXX.*a*, XXX.*b*, XXXI.–XXXIV.
Note particularly the Theory of Factors.

Girls.—Read carefully pages 1–23 'Girls' Arithmetic.' Learn all definitions, and work Ex. VII. (Simple Practice).

Second Year.

Boys.—Lock, Ex. LIII., LIV., and LV.

Girls.—'Girls' Arithmetic,' Ex. XII. and XIII.

Third Year.

Boys.—Lock. Revise Interest, and work Ex. CXXII. and CXXIII.

Girls.—'Girls' Arithmetic' : Addition, Subtraction, and Multiplication of Decimals.

C.—*Music.*

First Year.—The Common Major Scale, its structure and intervals.

Second Year.—First removes of key.

Third Year.—The Minor Scale and its intervals.

D.—*Spelling.*

Learn 200 words from 'Words Commonly Misspelt,' or any good list.

E.—*Geography.*

The Geography for the year presents a wide range and will need careful preparation. In preparing this subject, take a good note-book, on the left hand page draw an outline map of the country to be studied, enter into it those names, etc., which have to be remembered, and no others. The right hand pages will then contain notes, summaries of facts, etc. With each country, a table should be prepared to show its productions, industries, imports and exports, government, and religion. A list of the chief towns with a few facts about each should also be noted. The note-book should form a complete digest of the text-book, with additional facts from other sources.

Too much stress cannot be laid upon the necessity of drawing maps continually.

EUROPE.—Extent, Coast-line, Rivers, Mountains, Plains, Lakes, Productions.

The following are the chief points :—

Situate in the N. Temperate Zone, the home of civilization and progress. Coast deeply indented, no place (except in Eastern Russia) more than 500 miles from sea.

Capes.—Nordkyn on mainland, North Cape on Island of of Mageroe, most northern points; Finisterre (= land's end), Matapan in Greece, etc.

Seas.—White Sea : On account of snow and ice closed during greater part of year.

Baltic Sea : Water fresher than sea, owing to immense amount poured in by rivers and no evaporation.

North Sea (German Ocean) : Rough, wild, shallow (Dogger Bank).

Mediterranean (= Lat. middle of the earth) : Derives its name from being the middle of the world as known to the Romans.

Tyrhennian : Between Corsica, Sardinia, and Italy.

Adriatic : Named from Adria, formerly an important port, now some miles inland.

Archipelago (arche = chief, pelagos = the sea, Greek), the *chief* sea, because most of their traffic lay across it. (Now applied to any sea containing numerous islands.)

Sea of Marmora.

Black Sea : On account of storms called by the Greeks the Euxine.

Sea of Azov.

Caspian Sea : A vast, salt lake, originally much larger.

Note similarly Straits, Islands, etc.

Mountains.—Generally in the centre and south. The point from which the various systems radiate is Mont St. Gothard. Start from this point, and trace the following lines :—

(1) *West :* Bernese Oberland (Jungfrau, Finster Aarhorn, Schreckhorn), Jura Mts., Cevennes, Pyrenees (Mt. Perdu, Pt. du Midi), Mts. of Spain (Asturias, Castile, Toledo, Morena, Nevada).

(2) *South :* Lepontine Alps, Pennine Alps (Mt. Blanc, Matterhorn, Rosa, Gt. St. Bernard), Graian, Cottian, and Maritime Alps, continued through Apennines.

(3) *North East :* Rhœtian Alps, Black Forest, Rhine Alps, Hartz Mountains, and Vosges.

(4) *North West :* Bohmer Wald, Erz Geberge, Riesen Geberge, Sudetic Mts., Little Carpathian, Carpathians, and Transylvanian Alps.

(5) *South West :* Noric, Carnic, Julian, Dinaric Alps, Mt. Pindus, Balkans, Despoto Dagh.

The outlying systems.—(1) Scandinavian, Kiolen Mts. (Sulitelma), Dovre Field, Hardanger Field (Sneehatten) ; (2) Caucasus.

Tabulate, learn principal peaks and heights.

Rivers.—Classify as falling into Arctic Ocean, Baltic, Atlantic, Mediterranean, and Black Sea. Learn principal lengths—note directions, but omit tributaries, etc.

Plains.—Plain of Andalusia (Spain), Landes (level marshy tracts, S.W. of France), Plain of Languedoc, Plain of Lombardy (N. Italy), Hungarian Plain, Russian Plains (in the N. *Tundras*, W. and S. *Black Lands*, S.W. *Steppes*), Gt. European Plain stretching from Urals to the North Sea.

Lakes.—Note and learn position of following :—Ladoga, Onega, Wener Wetter, Malar ; Garda, Como, Lugano, Maggiore, Constance, Geneva, Neufchatel, Lucerne, Zurich, Thun, Brienz, Bienne, Morat, Zug, Caspian.

Climate.—With exception of northern parts of Scandinavia and Russia, Europe lies wholly in the north temperate zone. Being so interpenetrated with seas, the climate is largely modified, the summers being less hot and the winters less cold than they otherwise would be. Russia is an exception to this. Note the very great influence of the warm Gulf Stream on the western coast ; compare with American countries of same latitude. There are many local modifications which will be noted under the various countries.

Productions.—

A. *Vegetable.*—The continent may be divided into four zones or belts.

1. Sub-tropical.—Vine, olive, maize, orange, lemon, almond, cork, rice, fig, etc.

2. Warm Temperate.—Vine, wheat, maize, apple, plum, pear.

3. Temperate.—Wheat, barley, oats, rye, flax, hemp, deciduous trees.

4. Cold Temperate.—Barley, potato, pine, birch, willow, ash, fir, lichens and mosses.

B. *Mineral.*—Gold, Urals and Transylvania ; silver and lead in Spain, England, Norway, and Urals ; quicksilver in Spain and Austria ; copper in England, Russia, and Sweden ; iron and coal in Britain, Germany, France, Belgium, Austria, etc. ; sulphur in Sicily ; salt in many parts, especially in Austria ; petroleum in Russia (shores of Caspian).

C. *Animals.*—All the domestic animals.

Wild Animals.—Polar bear, reindeer, wolf, chamois, ibex, buffalo, lynx, brown bear, the principal. Fish of all kinds. Birds well known.

PEOPLES OF EUROPE.

The peoples of Europe belong to two great families—the Indo-European and the Mongols.

The following table shows their distribution and classes:—

INDO-EUROPEAN.

Celtic.—Gaels (in Scotland), Irish, Welsh, Manx (Isle of Man), Armoricans (Brittany).

Teutonic or German.—Scotch Lowlanders, English, Dutch, Flemings, Germans, Austrians, Danes, Norwegians, Swedes, Icelanders, and North Swiss.

Græco-Latin.—Greeks, Italians, South Swiss, French, Belgians, Spanish, Portuguese, and Roumanians.

Slavonic.—Russians, Poles, Moravians, Bohemians, Servians, Bulgarians.

MONGOLS.

Finns, Magyars (Hungary), Turks, Tartars, Calmucks (Russian Steppes).

In addition, there are many Gypsies, Jews, Armenians, and Circassians.

F.—*History.*

Edward II., Edward III., and Richard II.

Edward II.—1307–1327.

Note under the following heads :—

(*a*) Character—Weak, pleasure-loving, worthless.

(*b*) Favourites—Piers Gaveston, executed 1312. The two Despensers (father and son), 1322–26.

(*c*) The Lords Ordainers, 1311. Overthrow at Boroobridge, 1322.

(*d*) Inglorious close of Scotch war.

1308–1313. Continued success of Bruce, and decline of English power.

1314. Battle of Bannockburn.

1314–1322. Bruce carried the war into England.

1323. A long truce, which practically acknowledged Bruce's right.

1326–27. Rule of Isabella and Mortimer, and murder of King.

Edward III.

Chief points :—

1. During first three years, country ruled by Isabella and Mortimer. Then Edward assumed personal rule.

2. This reign is remarkable for three things:—(*a*) Successful military operations abroad ; (*b*) steady constitutional growth at home ; (*c*) great distress amongst the poor—the beginning of a great social revolution.

3. Constitutional growth—

1340. Abolition of tallage.

1352. Statute of Treasons (limiting treason to certain clearly-defined acts).

1362. English used in Law Courts. Purveyance abolished.

1376. The Good Parliament.

Church matters :—

1351. First Statute of Provisors. This prevented the Pope appointing to vacant benefices in England foreigners who had no sympathy with or interest in the country.

1353. Statute of Præmunire, directed against Papal jurisdiction in England. *Very important.* The first step towards an independent national Church.

John Wycliffe and the Lollards introduced new ideas on religious duties.

It is very important to follow the condition of the lower class of people throughout the history. In Norman times the labourers were reduced to a condition of serfdom or practical slavery. They possessed no rights, no education, and few ideas. With the increase of prosperity in the country that position improved, and they began to realise the injustice of their position. The Hundred Years' War with France resulted in many of them being freed, and the teaching of Wycliffe and the Lollards gave them new ideas and hopes. In 1349 the Black Death swept over the country, and destroyed at least one-third of the population. This caused great scarcity of labour and a tendency for wages to rise. Consequently, in 1349 and 1351, statutes were passed (called Statutes of Labourers) limiting wages to what they were before the Black Death. In 1361–62–69 further visitations of the Black Death occurred. The new laws pressed heavily upon the peasants, who were anticipating better times, and discontent became general. This resulted in a revolt, of which we shall hear in the next reign.

Foreign affairs :—

Scotland.—In 1329 Robert Bruce died, and three years later Edward Balliol—the son of the unfortunate John Balliol, king in Edward I.'s time—was, with the support of the English, made king, but was soon driven out. In 1333 Edward, invading Scotland to support Balliol, won the battle of Halidon Hill, and took Berwick. The Scots, however, showed strong resistance, and Balliol retired to England, and David Bruce became king. Henceforth a permanent alliance was formed between the two countries, Scotland and France, and in 1346 David Bruce, invading England to help France, was defeated and captured at Neville's Cross.

France.—The Hundred Years' War.

Causes :—

(*a*) The jealousy and continual contests between French and English seamen.

(*b*) A French attack on the Isle of Wight, encouraged by Philip.

(*c*) The help the French had given the Scotch.

(*d*) The interference of France in the affairs of Aquitaine, then English property.

N.B.—The claim of Edward to the French throne was nothing more than a form. The Salic Law nullified his claim, and if it did not there was another who stood before Edward in rights—namely, Charles, King of Navarre. The adoption of the title 'King of France' was, probably, only a means to attract doubtful French vassals to Edward's support.

Events :—

1338–42. The only engagement was the battle of Sluys (1340), which the English won. The same year a truce was signed at Esplechin, which lasted five years.

1345–47. Great invasion of France. Battle of Crecy (1346), and capture of Calais.

1347–55. A quiet period.

1355–57. The Black Prince raided Languedoc and the country north of the Loire. Battle of Poitiers.

1360. Treaty of Bretigny.

1369. Revolt of Aquitaine. Repression by Black Prince.

1371–75. English lost most of their possessions.

1375. Treaty of Bruges.

Results :—The establishment of a feud and hatred between the two countries which has not yet entirely died out.

The consolidation of the English nation.

Richard II.

(*a*) The King's minority.—Preponderating influence of John of Gaunt. A time of weak government, heavy taxes, and quarrels among the nobility.

1381. The Peasants' Revolt.—As pointed out before, the Commons of England had for some continual time been very discontented with their position. They had no privileges whatever, their wages were fixed by Parliament, and there was no possibility of a man's improving his social position. They were ill-treated by the barons and clergy, who lived a lazy life on the hard work of the poor. The causes which led to the outbreak in 1381 were of long standing, dating, in fact, from the Conquest. The sturdy Saxon spirit and love of freedom could ill bear the position of serfdom. The more immediate causes were the Black Death, the general discontent at the decline of English power in France, the heavy taxation, and finally the most unjust Poll Tax. It only needed a spark to cause the smouldering discontent to break out into open flame, and this was supplied by Tyler's act in killing a collector.

'All over England, in Yorkshire, Kent, Lancashire, Devon, the people rose, though not everywhere for the same reason. Sometimes the clergy, sometimes the landlords, sometimes the lawyers, were the special objects of the popular fury. Each man had his own particular grievance, and they were bound together rather by general discontent than by common aims. They communicated with one another partly through the Lollard preachers and partly through the organisations formed to resist the Statute of Labourers.'

In a fortnight all was over, and it seemed that the people had gained nothing. But, though the rising was put down with merciless cruelty, it was in reality the death-blow of villenage. Most of the demands of the peasants were in a few years conceded.

(*b*) Constitutional rule of Richard, 1389–97.

(*c*) Despotic rule, 1397–99.

(*d*) The Lancastrian Revolution and Deposition of Richard.

Points to be noted.—The Lords Appellant, the Merciless Parliament, the rise of the Lollards. The Papal Schism (there were *two* Popes, one at Rome, supported by Italy, and one at Avignon, supported by France). The great Statute of Præmunire.

G.—*Euclid.*

First Year.—The definitions, axioms, and postulates.

Second Year.—Book I., Propositions 27 and 28.

H.—*Algebra.*

Read chapters 1–4 'Scholarship Algebra,' and work all exercises thereon.

I.—*Teaching.*

Second Year.—The three systems of teaching Reading; the best method.

Third Year.—The teaching of Grammar and Composition.

TEST QUESTIONS.

1. *Penmanship.*—Write as a specimen of—
Large-hand :—Alphabetical, Alliterative, Alphabet, and Analysis.
Small-hand :—
'Authority forgets a dying king.'

'Arethusa arose from her couch of snows
In the Acroceraunian mountains.'

2. Write an essay each week, choosing from the following subjects :—

(*a*) Friends ; (*b*) War ; (*c*) the Navy ; (*d*) Railways ; (*e*) Weapons of War ; (*f*) Newspapers ; (*g*) Happiness.

3. *Notes of Lesson.*

First Year Pupil Teachers should write outline notes; Second and Third Years full notes:—

(1) Water ; (2) the Oak Tree ; (3) Bees ; (4) Chalk ; (5) the Three States of Matter; (6) Lakes; (7) a Sovereign; (8) Paper.

4. Paraphrase and analyse the following, and parse words in italics :—

First Year.—(Omit paraphrase.)

(*a*) Cowards die *many times* before their death,
The *valiant only* taste of death *but once.*

(*b*) *But* knowledge to their eyes *her ample page*
Rich with the spoils of *time did ne'er unroll.*

(*c*) *Having reached* the house,
I found *its rescued inmate* safely lodged
And in *serene* possession of *himself*
Beside a fire.

Second Year.

(*a*) *Had'st* thou *but lived, though* stripped of power,
A *watchman* on the lonely tower,
Thy thrilling trump had roused the land
When fraud or danger *were at hand.*

(*b*) Slowly steals the *music over*
All the *hillsides* waving green,
Where on fields of daisied clover
Raindrops lie in *summer sheen.*

Third Year.

(*a*) *There* are *who* have at midnight *hour*
In slumber *scaled* a dizzy tower,
And on the *verge that beetled o'er*
The ocean *tide's incessant* roar
Dreamed calmly *out* their dangerous *dream*
Till wakened by the morning beam.

(*b*) By torch and trumpet *fast arrayed*
Each horseman drew his battle blade,
And furious every charger *neighed*
To join the dreadful revelry.

Then *shook* the hills with thunder riven,
Then rushed the steed to battle driven,
And *louder than* the bolts of heaven
Far flashed the red artillery.

5. What was the Black Death? Give the date and state its effects as fully as you can.

SCHOLARSHIP COURSE FOR DECEMBER, 1895.

WORK FOR THE MONTH.

Reading and Copy-setting.—A few minutes' practice at each should be taken every day.

1. *Spelling.*—250 words from 'Words commonly Misspelt,' or any good list.

Occasional practice in writing from dictation should be taken. The pieces which have previously been set, or an extract from such a writer as Macaulay, will be good practice.

2. *Composition.*—Write one or two essays each week, selecting the subjects from the following :—

1. A sea voyage.
2. The uses of discipline.
3. Common sense.
4. Co-operative stores.
5. The month of November.
6. 'Penny wise, pound foolish.'
7. Party feeling.
8. 'Familiarity breeds contempt.' How far is this true?
9. The Panama Canal.
10. The evils of unpunctuality.

(As essay should be sent in occasionally for examination and criticism. Too much attention cannot be given to this subject, which affects all written papers.)

Draft an analysis of each essay before writing, and enter in a note-book. Read up the subject if necessary, but do not consult any book while writing.

3. *English.*—(1) Analyse the following extracts and parse the words in italics :—

(*a*) 'Here about the beach I wandered, *nourishing* a youth sublime
With the fairy tales of science, and the long *result* of Time,
When the centuries behind me *like* a fruitful *land* reposed,
When I clung to *all* the present *for* the promise that it closed,
When I dipt into the future *far as* human eye could see,
Saw the vision of the world and all the wonder that *would be.*'

(*b*) '*Some* blue peaks in the distance rose,
And *white* against the cold white sky
Shone *out* their crowning snows.
One willow over the river wept,
And shook the wave *as* the wind *did* sigh.
Above in the wind was the swallow
Chasing *itself* at its *own* wild will.
And *far* through the marsh, green and still,
The tangled water courses slept,
Shot over with purple, and green, and *yellow.*'

(*c*) 'I smile *to see* underling pretenders, and who live in a country *scarce* designed in the exactest maps, sweat and toil for *so* unmassy a reputation, that, when it is hammered out to the most stretching dimensions, will not *yet* reach the nearest towns of a neighbouring country ; *whereas*, examine *such as* have *but* lately returned from travelling in most flourishing kingdoms, and *though* curiosity was their greatest errand, *yet* you shall find that they scarce know who is chancellor or *president* in these places.'

(*d*) 'Learning is *like* a *river* whose head being *far* in the land is *at first* rising little and easily viewed ; *but, still as* you go, it gapeth with a wider bank, not without pleasure and delightful winding, while it is on both sides set with trees and the beauties of various flowers. But still *the further* you follow it, the deeper and the broader 'tis ; till at last, it inwaves *itself* in the unfathomed ocean ; there you see more water, *but* no shore —no end of that liquid, fluid vastness.'

(2) Learn 50 Roots, with meanings and examples.

(3) *Literature.*—Revise English literature from Anglo-Saxon times to 1485. Note especially the effect of the Norman conquest on the language, the gradual fusion of the two, and the earliest English works. Note Chaucer and his influence particularly.

(4) Revise Grammar and Syntax of Conjunction and Preposition.

4. *Arithmetic—Men.*

(1) (*a*) State the rule for finding the L.C.M. of two numbers and prove it (as to a class) for the numbers 65 and 78.

(*b*) Prove that $\frac{3}{4} = \frac{9}{12}$.

(*c*) Shew by a diagram that $30\frac{1}{4}$ square yards = 1 square pole.

(*d*) Define ratio, proportion, interest, and discount.

(2) Reduce $\frac{4578}{4685}$ and $\frac{1998}{2043}$ to their lowest terms, and divide their difference by their sum. Ans. $\frac{1}{11}$.

(3) A, B, and C start at the same time, in the same direction, and from the same place in a circular course to run round it. A takes 252 seconds, B 231 seconds, and C 198 seconds to do so. When will they next meet at the place from which they started? Ans. 2772 secs.

(4) A can walk round a rectangular field, whose sides in yards are 411·6 and 548·8, in the same time that B takes to walk from one corner to the opposite corner and back. Find the ratio of their rates. Ans. 7 : 5.

(5) A wine glass is filled with a mixture of spirit and water in the ratio of 1 of spirit to 4 of water, another glass of the same size is filled in the ratio of 2 of spirit to 5 of water. Find the ratio of spirit to water when the contents of the two glasses are mixed. Ans. 17 : 53.

(6) Seven per cent. was lost by selling a carriage for £69 15s. od., and 4½ per cent. was gained by selling a horse for £94 1s. od. How much was gained or lost on the whole? Ans. £1 4s. od. lost.

(7) Find the exact compound interest on £3,976 for 2 years at 4 per cent. Ans. £324 8s. $9\frac{132}{625}$d.

(8) How much must be invested in the 3 per cent. at 99 to produce the same income as would be obtained by investing £1,508 in the 2½ per cents. at 87. Neglect brokerage. Ans. £1,430.

Girls.—

Define the following:—Measure, product, subtrahend, square, percentage, consols, dividend.

(2) A tradesman loses 9 per cent. by selling goods for £817 19s. od.; at what price should he sell to gain 10½ per cent.? Ans. £993 4s. 6d.

(3) A train travelling 33⅓ miles per hour makes a journey in $2\frac{7}{24}$ hours. In what time would it have traversed the same distance if the speed had been 38½ miles per hour? Ans. 2 hours.

(4) If a grocer gains one-eighth of the cost price by selling tea at 3s. per lb., how much per cent. would he gain if he sold the same tea at 3s. 4d. per lb.? Ans. 25 per cent.

(5) Place within each of the brackets below the number required to complete the statement of proportion and give the rule:—

(*a*) 64 : ( ) :: 576 : 25
(*b*) ·004 : 1·4 :: ·02 : ( )
(*c*) ( ) : 17 :: 804 : 67
(*d*) 832 : 122 :: ( ) : 2440.

Ans. 25, 7, 204, 16,640.

(6) Two numbers together make 360. They are in proportion of 2 to 7. What are they? Ans. 80 and 280.

(7) Air is composed of 75·55 per cent. nitrogen, 23·22 per cent. of oxygen, and 1·23 per cent. of carbonic acid. In a chamber containing 6,548 cubic feet how much is there of each gas. Ans. N, 4947·014; O, 1520·4456; C 80·5404 c. feet.

(8) Give the equivalents of the following decimal expressions in English money, and of the following sums of money in decimals of a pound. Work by simple inspection.

(*a*) £16·25, £1·025, £7·16, £2,034·875.
(*b*) £2 12s. 6d., £134 10s. od., 7s. 6d., £1 1s. od.

Ans. £16 5s. od.; £1 0s. 6d.; £7 3s. 4d.; £2034 17s. 6d.; £2·625; £134·5; £·375; £1·05.

5. *Algebra.*—

Girls.—Read Chapters XIV. and XV., 'Scholarship Algebra,' and work examples therein.

Boys.—Study very carefully Chapter XXX. 'Scholarship Algebra,' and work Exercise XXX. (N.B.—This a most important Chapter.)

Revise mensuration of rectilineal figures.

6. *Euclid.*—Revise Book I., 27–48. Practise writing-out, and work as many deductions as possible.

7. *Geography.*

(1) Practise memory maps regularly.

(2) Revise Asiatic possessions with Australasia.

(3) *The Geography of England.*—This must be prepared in fuller detail than it was for the Pupil Teachers' Examination. The rivers must be carefully prepared, and maps of basins of the principal ones (*e.g.*, Severn, Thames, Trent, Ouse, etc.) committed to memory.

Each county must be taken in detail, the industries, towns, and places of interest carefully noted.

The manufactures, imports and exports, lines of railway, canals, universities, government, and all other details must be thoroughly mastered.

The following are a few typical questions:—

(1) Name and describe the leading industries of England, and assign reasons why each should be placed in its particular seat.

(2) What towns or districts in the United Kingdom are noted for the manufacture of lace, carpets, locomotives, glass, leather, earthenware, and linen; the smelting of iron, the quarrying of slate, and lead and copper mining?

(3) Draw a map of the west coast of England.

(4) The Black Country, the Fens, the New Forest, the Lake District. Describe briefly the situation and character of each.

(5) Give an account of the physical features, including industries and places of interest to travellers in *one* of the following counties: Devon, Warwick, Carnarvon, Durham.

(6) Draw a map of the six northern counties of England, marking the seaports and positions of Manchester, Leeds, Sheffield, Bradford, Oldham, Blackburn, and Durham.

(7) Draw a map of the east coast of England, marking the boundaries of the counties which adjoin the sea on that side, their ports and chief towns.

(8) Name the principal industries which have arisen upon the Northumberland, South Lancashire, and Warwickshire coal-fields, and point out the natural causes of the growth of those industries.

(9) In what parts of England are leather, iron, and woollen goods severally manufactured? Name three towns engaged in each of these industries.

(10) Give some account of the chief places passed in coasting from the Nore to Plymouth.

(11) What parts of the British Isles produce the best horses, mutton, butter, cheese, apples, wheat, oats, and flax?

(12) Draw a map including the basins of the Severn and Wye, or of the Mersey, Ribble, Lune, and Eden.

(13) Give in tabular form the manufactures of Derby, Newcastle-on-Tyne, Bradford, Sheffield, Blackburn, Dublin, Stoke-on-Trent, and Norwich.

(14) Contrast the eastern and western shores of England.

(15) Describe the Lake District of England, stating accurately the position of the lakes.

(16) Name the chief productions imported into Great Britain from her Asiatic possessions, specifying the place from which each comes.

(17) Describe a trip by steamer from London to Newcastle, with a sketch map of the coast.

(18) What parts of Great Britain are distinguished from the rest (*a*) as the flattest, (*b*) as the most elevated, (*c*) as the most beautiful, (*d*) as the richest in minerals, (*e*) as the most populous. Give details.

(19) Give some account of the advantages of the position of London for (*a*) the capital of England, (*b*) a centre of international trade. By what railway routes could you travel (*a*) from London to Plymouth and (*b*) from London to Manchester. State briefly in what districts the nature of the country caused especial difficulty in the construction of railways.

(20) Give a summary of what you know of London under these heads: (1) Position, (2) Approximate area and population, (3) Supply of food and fuel, (4) Commercial and financial importance, (5) Access to seaside watering places.

8. *History—Elizabeth—Home Affairs—Church Matters.*—

The bitter feeling between Catholics and Protestants which had arisen out of the Marian Persecution was one of Elizabeth's difficulties. In this, as in foreign affairs, her policy was to steer a middle course, and, if possible, to allay the antagonism existing. She was at heart a Catholic, but she had sufficient insight to see that any extreme course would rather hinder than forward the development of the nation which she so much desired. Pius V. expected that she would re-establish the Catholic religion in some modified form, and it was not till 1570 that, finding he had made a mistake, he proceeded to open hostility and formally excommunicated Elizabeth. What the result might have been had this step been taken earlier in the reign it is difficult to say, but during the 12 years that had elapsed since Elizabeth ascended the throne, she had so clearly proved her worth that the blow fell flat. Parliament retaliated the Papal attack by declaring in 1571 that reconciliation with

the Church of Rome was treason. In 1580 the Jesuits invaded England to preach rebellion, and this step was answered in 1581 by a severe Act which forbade mass in private houses. Campion was executed. Up till the Armada there was continual intriguing and plotting by the priests, but that event appealed to the patriotism of the nation, as we have seen, and lessened the bonds with Rome. From then till the end of the reign there was less trouble.

The Established Church.

1559.—Parliament passed the Act of Supremacy constituting the Queen 'Head of the Church' and the Act of Uniformity which, with some alterations, enforced the 2nd Prayer Book of Edward VI.

All the bishops but one were deprived of their sees.

Parker became Archbishop of Canterbury.

The same year the Ecclesiastic High Commission Court was first established to try ecclesiastical offences and to enforce the terms of the above acts. It was composed of twelve bishops and thirty-two members. The illegal use made of it by the Stuarts led to its being abolished in 1641.

1566.—Some thirty London clergymen were deprived of their livings for refusing to wear surplices. This is the beginning of dissent. Some of them formed separate congregations and received the term Brownists (from Robert Brown), or Independents.

1576.—Grindal became Primate, but was suspended by Elizabeth for his sympathy with the Puritans.

1583.—Whitgift succeeded him, and the Court of High Commission was reorganised.

A few years later the famous Martin Marprelate controversy broke out. This took its name from the pseudonym of the writers of many tracts attacking the Prelates. These tracts were written in the bitterest and most insulting terms, the object of the writers being rather vituperation than argument. In 1592, one Penry, who was supposed to be the author of some of them, was executed for libel.

Trade and Commerce.—We have seen that at the commencement of the reign trade was nearly paralysed and commerce was hardly known. One of the reasons of this was the debased state of the coinage, that is, the coins were not nearly worth their value. The early years of the reign were devoted to calling in and reminting the money—at a large cost, be it remembered—a step which had the best possible effects.

Under the strong and peaceful home policy of Elizabeth, trade began to revive.

The establishment of the Inquisition in the Netherlands in 1522 and the subsequent violent persecution which ensued was indirectly a good thing for England. More than 30,000 Flemish weavers fled to England and they were cordially welcomed by Elizabeth, who gave them settlements in Norwich and Sandwich on condition of their employing at least one English apprentice each. The English thus learned the arts of cloth-making, silk-making, and dyeing, and instead of exporting their wool and then importing Flemish cloth they manufactured their own goods, and thus laid the foundation of a great national industry. English cloth was exported to all the countries of Europe by the Merchant Adventurers. Manchester frieze, Halifax cloth, Sheffield cutlery, became famous.

In 1553, a vessel, commanded by Richard Chancellor, made its way to Archangel and laid the foundation of the trade with Russia. Four years later the Emperor of Moscovy (as Russia was then called) sent an ambassador to England.

The maritime discoveries opened up new fields for profitable commerce, and ere long gold, silver, and tobacco were coming from America, gold-dust and ivory from Africa, silks and cotton from the East, spices from the Spice Islands, and in 1560 Sir Thomas Gresham built the Exchange in London, which was visited by Elizabeth and named the Royal Exchange. The colonising expeditions to America, though not a success, still stimulated commercial enterprise, and in 1599 Elizabeth granted a charter to a company of London East India merchants, who thus formed the beginning of our great East Indian Empire.

This increase of foreign commerce led naturally to increased prosperity at home and to the revival of all home trades and industries. This is evinced by the great and increased wealth of the merchant princes and the great improvements in architecture.

Elizabeth and the Parliament.—The high prerogatives exercised by the Tudors necessarily led to a stagnation in Parliamentary advance. Elizabeth, by her policy of economy, was under no necessity to summon a Parliament often; when they were called together, they generally supported her policy. There is one point which should be noticed: In 1597, Parliament courageously attacked the system of monopolies, and in 1601 they renewed their attack, and the Queen was wise enough to withdraw them. The same Parliament passed the first *General Poor Law*. With these exceptions the reign is singularly barren of useful legislation.

The Poor Laws.—As we have seen, the Labour problem became one of importance in Edward III.'s reign, when the Statutes of Labourers were passed. The attempt to regulate work and to do away with poverty by legislation was, as might have been anticipated, a failure. That there was much suffering from poverty was evinced by the various risings which took place. Up to 1536 the only place to which a starving person could look for relief was some monastery, where food was always provided for the destitute wanderers. When these institutions were abolished, the sufferings of the poor became more acute, and we have the rising of 1536, known as the Pilgrimage of Grace. Shortly after this event the churchwardens of the parishes were ordered to collect alms for the impotent poor, and to find work for the able-bodied. Giving of alms was not, however, compulsory.

In the first year of Edward VI. another attempt was made to deal with vagabonds refusing work by passing a severe statute against them. The voluntary relief system was in 1563 replaced by a regular rate on the parish. In the same year, the wages, times, and conditions of labourers were revised; in 1572 houses for the impotent poor were established, and in 1576 houses of correction. In 1597 the overseers were directed to meet monthly for the relief of the poor, to buy stores of hemp for their employment, to apprentice their children, etc. In 1601 all the preceding regulations were revised and embodied in one law, which established the modern system of relief with but few exceptions.

Prepare also lives of the following:—Cecil, Bacon, Walsingham, Essex, Raleigh, Leicester, Sidney, Hatton, Drake, Hawkins, Wooton, etc.

9. *School Management.*—Revise the teaching of Writing, Dictation, and Composition.

10. *Domestic Economy.*—Revise the subject of Food and Food Stuffs.

11. *Music.*—Revise any points not known.

12. *French.*—Ten pages of 'Le Trésor.' Revise Irregular Verbs.

Test Questions.

1. Who were the writers of the following works:—*Stones of Venice, Hypatia, David Copperfield, Idylls of the King, Warren Hastings, Heroes and Hero Worship, Esmond, Silas Marner.* Give a brief summary of the contents of one of them.

2. Compare and contrast Milton and Tennyson as poets.

3. Give examples of English words derived from the following languages:—Arabic, Italian, Dutch, French, and Spanish.

4. Comment on the following:—*Yclept, methinks, prithee, worth, children, afoot, gammer, ought.*

5. Explain clearly the difference between *reverend* and *reverent, continual* and *continuous, older* and *elder, true* and *truthful, momentous* and *momentary.* Use each pair of words in a sentence.

6. Write full notes of a lesson on (*a*) Abstract Nouns; (*b*) Prepositions of Place; (*c*) Analyses of sentences containing Adjective clauses.

7. (*Girls.*) (*a*) Add together $3x^2 - x^3 + 2x - 1$, $2x^3 - 7x + 2x^2 + 3$, $9x + 4x^2 - 8$, and $x^3 - 8x^2 + 5x + 4$.

Ans. $2x^3 + x^2 + 9x - 2$.

(*b*) From $\frac{3}{4}a^2 - \frac{5}{6}a + \frac{7}{10}$, take $\frac{1}{5} - \frac{4}{3}a - \frac{a^2}{4}$.

Ans. $a^2 + \frac{1}{2}a + \frac{1}{2}$.

(*c*) Multiply $\frac{1}{4}y^2 - \frac{1}{8}yz + \frac{1}{8}z^2$ by $\frac{1}{2}y + \frac{1}{2}z$.

Ans. $\frac{1}{8}y^3 + \frac{1}{16}z^3$.

(*d*) $12x^4 - 17x^3 - 9x^2 + 13x - 63 \div 4x^2 - 3x + 7$.

Ans. $3x^2 - 2x - 9$.

(*e*) $\frac{x}{3} - \frac{x-4}{5} - \frac{30-x}{6} = \frac{x}{4} - \frac{12-x}{3} - 7$.

Ans. $x = 24$.

(*Boys.*) (*a*) Simplify—

$$\frac{a^2+b^2+2ab}{2ab} \times \frac{ab^2}{a^3+b^3} \div \frac{4a(a+b)}{a^2-ab+b^2}$$

Ans. $\frac{b}{8a}$.

(*b*) Find the value of $\frac{x^3-y^3}{x^3+y^3}$ when $x = a+3$, $y = a-3$.

Ans. $\frac{9(a^2+3)}{a(a^2+27}$.

(*c*) Express in the simplest form:—

(i.) $\left\{(16)^{-\frac{3}{4}}-(81)^{-\frac{3}{4}}\right\}\div\left\{(16)^{-\frac{1}{4}}+(81)^{-\frac{1}{4}}\right\}$

Ans. $\frac{19}{180}$.

(ii.) $8^{\frac{4}{3}}+\sqrt[3]{2.4^{-5}}-\frac{\sqrt[7]{2}}{4^{-\frac{3}{7}}}-(32)^{-\frac{3}{5}}$. Ans. 14.

(*d*) Resolve into factors:—

(i.) $36x^4-97x^2+36$.

Ans. $(3x+2)(3x-2)(2x+3)(2x-3)$.

(ii.) $112x^2+138xy-135y^2$.

Ans. $(14x-9y)(8x+15y)$.

(*e*) Solve $8xy-13y^2=3$, $13x^2-21xy=10$.

Ans. $x=\pm2, \pm5$; $y=+1, +3$.

(*f*) The number of sergeants in a company is twice the number of officers, and is equal to the number of companies in a battalion, there is an officer or sergeant to every 10 men, and the whole battalion (including 6 on the staff) numbers 600. How many companies are there? Ans. 6.

8. What do you know of the Deccan, The Great Karroo, and the Terai?

9. Give a short account of the climate and productions of Cape Colony.

10. What changes have been made during recent years in the boundaries of British Possessions in South Africa? Give some account of Mashonaland.

11. What do you know of English relations with the Netherlands during Elizabeth's reign?

12. How do you account for the defeat of the Armada? Do not give any account of it, but merely trace the causes which led to the result.

13. What was Elizabeth's foreign policy? Illustrate your answer by reference to events.

14. (*Euclid.*)

(*a*) Prove I. 32. What is the size of the angle of a regular pentagon.

(*b*) Prove II. 11.

(*c*) Under what conditions will the lines bisecting the opposite angles of a parallelogram be coincident.

(*d*) ABC is a triangle right angled at B. From P, the middle point of BC, PQ is drawn perpendicular to AC. Show the difference of the squares on AQ; QC is equal to the square on AB.

15. Show what is the proper use of a blackboard as an aid for recapitulation. Give a specimen of the sketch which should appear on the board at the end of an object lesson.

16. Name some of the most effective, visible, and tangible illustrations for use in teaching *either* (*a*) Notation, *or* (*b*) Practice.

17. Write notes of a lesson on The Number 30, Silver, Reduction, Leaves of Trees, A Rainy day, The Midnight Sun, or a Reading Lesson.

18. (*Girls.*) (*a*) Name the warmth-giving, bone-forming, and flesh-producing elements in our ordinary food; give examples of articles of food in which each of these elements is found in the largest proportion.

(*b*) Name the more common and economical vegetables, and state how each may be cooked to the best advantage.

(*c*) State as precisely as you can the composition and nutritive value of (1) an egg, (2) lean beef, (3) beer, (4) cheese.

(*d*) Explain the process of digestion. What is the normal temperature of the body?

(*e*) Which is the most important of the condiments generally in use, and why? Name and describe some other common condiments, and show what purposes they serve.

(*f*) What does milk contain? Say why it is suitable to children. Is there any other article of diet which would serve equally well?

(*g*) Say how cheese is made, and what kinds of cheese contain the largest amount of nourishment.

(*h*) On what grounds are the French said to be in advance of us in regard to the economical preparation of food? Give particulars.

(*i*) What are the special advantages of fish as an article of food?

(*j*) Why do persons who lead a sedentary life require less food than those who work in the open air?

19. Write as a specimen of copy setting:—

(*a*) Large hand:—Descriptive Geometry.

(*b*) Small hand:—'Myriads of rivulets hurrying o'er the lawn.'

20. (*a*) What is the name for *doh* sharp, *te* flat, *fah* sharp, and *me* flat? Upon what principle are the names of the chromatic scale constructed?

(*b*) Write a minor scale (*lah* mode) ascending, using the essential sixth and essential seventh.

(*c*) How are the mental effects of notes modified?

CORRESPONDENCE.

1. Individual assistance will be given as far as possible by advice, solution of difficulties in any subjects, model answers, etc.
2. Specimens of Writing, Paraphrasing, Maps, Composition, etc., will be marked and criticised gratis.
3. To assist students in rural districts, Freehand or Model Drawings will be corrected and marked, with hints for improvement, etc., and returned if accompanied by a postage stamp.
4. As a rule, all replies will appear in the Correspondence Column, but anyone desiring an immediate reply may obtain it by enclosing a stamped, addressed envelope.
5. To ensure an answer in the next issue queries must be sent by the 15th of each month.
6. Name and address of sender, with coupon of current number of the PRACTICAL TEACHER, and *nom de plume* if desired, must be enclosed.

All communications and queries with regard to these courses to be addressed to Arthur T. Flux, 12, Lower Park Road, Belvedere, Kent.

ANSWERS TO CORRESPONDENTS.

A. DEATH.—Washing soda consists of crystals of the decahydrated salt $NaCO_3 10H_2O$, which effloresces in air, forming a white powder, $Na_2Co_3 5H_2O$. The other you mention is bicarbonate of soda, $NaHCO_3$, which is prepared by exposing soda crystals to a stream of CO_2.

NULLAH.—95 per cent. Slope rather too great.

ANSWERED BY POST.—E. P. (Rugeley); M. J. W. (Whitehaven); M. M. (St. Helens); A. B. (Heywood); A. R. (West Vale); F. P. (Sheldon); E. M. A. (Llanelly); M. E. (Bebside); Constant Subscriber (Totnes); G. R. M. (Poulton); D. W. (Hylton); L. T. (Blackwater); J. H. (Stowmarket); L. B. (Stockton); B. A. B. (Uttoxeter); E. M. C. (Uttoxeter); E. S. (Thirsk); W. E. B. (Ulverstone); B. W. (Stowmarket); C. R. Y. (Hastings); E. T., W. E. (Llanfyrnach); H. B. (Whitehaven); A. H. S. (Mansfield); M. O'M. (Manchester); E. G. (Stoke).

NEW COMPOSITION STORIES.—STANDARD V.

Suitable for 'Unseen Tests' in Reading also.

399.

A LESSON IN NEST BUILDING.—In olden times a great number of the feathered tribe came to the magpie, and asked him to teach them how to build a perfect nest: for he was the only one who could manage it. Mr. Mag was quite willing to lecture upon the subject, and began—'First of all, my friends, you must lay two sticks across, thus.' 'Ay,' said the crow; 'I thought that was the way to begin.' 'Then lay a feather on a bit of moss.' 'Certainly,' cried the jackdaw; 'I know that comes next.' 'Then place tow, feathers, moss, and sticks in this way.' 'Yes, of course,' said the starling; 'everyone could tell how to do that.' At last the magpie got vexed; and when he had finished half the nest, he said—"Gentlemen, I find you can all build nests, so you do not require me to teach you.' And away he flew. So to this day none but the magpie can build more than half a nest.

400.

HEROIC WOMEN.—The Emperor of Germany besieged a city which belonged to one of his rebellious noblemen. After the siege had lasted for a long time, the Emperor determined to take the city by storm, and destroy all it contained by fire and sword. He did not, however, wish to injure the defenceless women; therefore, he sent a proclamation into the town, saying that all the women might

leave the place unhurt, and carry with them whatever they held most precious. The nobleman's wife instantly decided to take her husband, and the other women followed her example. They soon issued from the city gate in a long procession, each one with her husband on her shoulders. The Emperor was so much struck with the noble conduct of the women that he spared all; even the city itself was left untouched.

401.

GEORGE II.—Whenever we hear of George II. at war, we are certain that he behaved himself like a soldier. At Dettingen his horse ran away with him, and with difficulty was stopped from carrying him into the enemy's lines. The King, dismounting from the fiery quadruped, said bravely: 'Now I know I shall not run away;' and placing himself at the head of his foot-soldiers, he drew his sword, brandishing it at the whole French army, and called out to his men to come on, in bad English truly, but with famous pluck and spirit.

402.

THE OLD SERGEANT.—During the Peninsular war a party of men was told off to attack a small fort situated on the side of a hill. They were commanded by a brave young officer, and under him was a veteran sergeant. The party advanced cautiously towards the fort under cover of trees; and then the word was given to 'Charge.' As they approached, they observed a breach out of which some half-dozen muskets were pointed. It was certain death for the first man who entered. Side by side the young officer and the old sergeant charged, but as the former was about to spring forward, a hand was placed on his shoulder, he was pulled back, and the well-known voice of the sergeant exclaimed, 'You are too young to die, sir.' At the same time the old man dashed into the breach, and fell pierced by the bullets of the besieged. The young officer rose to be a distinguished general in the British army; but he never forgot that he owed his life to the courageous devotion of his brave old sergeant.

403.

EDISON'S JOKE.—When the phonograph was first invented, Edison put one of the machines in his clock, and placed it in his spare bedroom. Being a great lover of a practical joke, he also placed a friend in the guest chamber one night. Just as his friend was unrobing he heard a voice exclaim: 'Eleven o'clock—one hour more!' It is needless to say that slumber did not descend upon the eyelids of the visitor during that hour. At midnight a voice exclaimed: 'Twelve o'clock—prepare to die.' This was too much for the astonished visitor, and he sprang from the bed and rushed to the library, where Edison and his friend were waiting patiently, expecting his appearance. The invention was soon explained and quiet restored.

404.

RETAINED HER FACULTIES.—A good story is told of a late Dublin doctor, famous for his skill and also his great love of money. He had a constant patient in an old shopkeeper. This old lady was terribly rheumatic and unable to leave her sofa. During the doctor's visit she kept a £1 note in her hand which duly went into his pocket. One morning he found her lying dead on the sofa. Sighing deeply, the doctor approached, and taking her hand in his he saw the fingers closed on his fee. 'Poor thing,' he said as he pocketed it, 'she was sensible to the last.'

405.

ABSENCE OF MIND.—A student in one of our universities had just started for a stroll down the town one evening, when he remembered that his fire was very low when he left his room. Not wishing to return to a fireless room, he hurried back, and soon made up a good fire. Setting out again, he noticed some of the people turning round to look at him and laughing. Presently some boys who came along called out 'Look at his cane!' On looking down, what was his horror to discover that he had been carrying the poker instead of his walking-stick.

406.

A MIRACULOUS ESCAPE.—One of the soldiers of the 14th regiment was singularly lucky in what appeared a chance mode of saving his life in one of the actions in which the regiment was engaged. The drum beating to arms before he had finished his dinner, he thrust a piece of bacon—far too precious a morsel in such uncertain times to be wasted—into the breast pocket of his coat. After the battle was over, the soldier discovered a bullet in the bacon; and ever afterwards, when thankfully recounting his miraculous escape, he used to say he was doubly fortunate, for not only did he save his bacon, but his bacon had saved him.

407.

PRESENCE OF MIND.—Presence of mind is an excellent quality, but not many would have the presence of mind of the soldier of whom this story is told. During a long and arduous siege, water became scarce and difficult to get, and one day this soldier, making a lucky find, attempted to gain some advantage from his good fortune. He carried a couple of buckets of water through the camp, crying: 'Fresh water! fresh water! threepence a bucket!' Just at this point a rifle ball came whistling through the air. It carried away the fingers of one hand. The bucket it held fell to the ground and the water was spilled. But unwilling to lose his profit, without an instant's pause the water-bearer cried out, 'Fresh water! Fresh water! sixpence a bucket!'

408.

HOW GOLD WAS DISCOVERED.—Some children playing on the banks of a stream in North America found a bright yellow stone. It was very heavy, but as the boy who discovered it was unwilling to part with it, he got his brothers to assist him in carrying it home. Their father set no value on it; he wanted food and clothing, and did not care for stones. He told his sons to place it as a prop against the lockless door, and thus for some years it served the purpose of keeping the door open by day, and shut by night. Many years afterwards, the stone was discovered to be an immense nugget of gold worth a great sum of money. The place whence it was taken became one of the most famous gold districts in America.

409.

RETRIBUTION.—A great many years ago, when barbarity in Egypt was even more excessive than it is at present, a certain Pasha was in the habit of daily inspecting his men in the barracks. One day a milkwoman (who generally supplied the milk) came to him and complained of a man having drunk all her milk. He grew in a rage and said, 'Are you sure?' 'Yes,' said the woman, 'quite sure.' In a few minutes the man was brought to him, and his head was struck off. The woman was horrified, and was more so when the Pasha had the stomach of the man opened, for there was her milk. The Pasha thereupon handed her the money for the milk, and remarked, 'You may go now, my good woman, but if I had not found the milk there I should have had your head as well.'

410.

A TRUE HERO.—The city of Marseilles, in France, was once afflicted with the plague. The city became as a desert, and funerals were constantly passing through the streets. The physicians were helpless, and as they met one day to talk over the matter, and see if something could not be done to prevent this great destruction of life, it was decided that nothing could be effected without opening a corpse in order to find out the mysterious character of the disease. All agreed upon the plan, but who should be the victim? For it was held certain that the operator would die soon after. Suddenly one of the most celebrated physicians, a man in the prime of life, rose from his seat and said: 'Be it so; I devote myself to the safety of my country. Before this numerous assembly I swear, in the name of humanity and religion, that to-morrow at the break of day I will dissect a corpse, and write down, as I proceed, what I observe.' He immediately left the room, and as he was rich he made a will, and spent the night in religious exercises. During the day a man died in the house of the plague, and at daybreak the following morning the physician, entered the room and made the examination. He then left the room, threw the papers into a vase of vinegar that they might not convey the disease to another, and retired to a convenient place, where he died in twelve hours.

411.

A WOMAN'S KIND HEART.—A tradesman in a small way of business having a bill of £20 to meet, was in great distress, on the day arriving, to find that he had but 25*s.* towards it. As he was very deep in thought as to what to do, a lady, collecting for a charity, came into his shop and asked him for 1*s.* towards her fund, which he gave her, saying, 'It cannot make much difference.' The lady, noticing his sad look, asked him what his trouble was, when he told her exactly how he stood. She at once replied: 'Well, I have £20 for which I have no immediate use, and I shall be glad to do good with it. I'll go home and fetch it, and you can repay me when you like. I shall never ask you for it.' She was, indeed, an unlooked-for friend.

412.

STORY OF BEECHAM'S PILLS.—Mr. Thomas Beecham, the founder of the large works at St. Helen's, Lancashire, where the manufacture of 'Beecham's Pills' is carried on, commenced business in a very humble way. On market days he was to be seen standing at street corners, a tray hanging from his neck, selling his pills. When trade was dull and sales not numerous, he would give a box to anyone standing near. A woman received one of these

boxes, and next market day returned to buy another, roundly declaring at the same time that the pills had done her a 'world of good,' and 'were worth a guinea a box.' This caught Mr. Beecham's ear; and now the phrase 'worth a guinea a box' is always to be seen in his advertisements.

413.

Doing His Duty.—A gentleman who lived some distance out of London had a season ticket from the City to the local station, which he passed through so often that he felt sure the railway servants knew him. One day, when the train stopped as usual, a collector came round to examine the tickets. This official was new to that station, and as the gentleman did not attempt to show his pass, he said sharply, 'Ticket, sir!' The gentleman, a very great man in his own estimation, at once replied: 'Here is my ticket,' at the same time handing him a beautiful morocco bound pocket book. 'Indeed, sir,' said the collector; then, quick as thought, he took his punch, and nipping a bit out of the gentleman's elaborate pocket book, remarked, to the amusement of the other passengers, 'Well, my orders were to punch all tickets passing through this station.'

414.

A Valuable Cheese.—A female miser who recently departed this life in Paris evidently had a fancy for cheese. When she died, a big box was found beneath her bed, and in this box was a cheese as hard as granite. Thinking the relic of no value, it was handed over to a grocer for a few francs. One day he attacked the cheese with a knife, and was surprised to find his weapon come rasping against something even harder. His surprise was increased when gold pieces came trickling out of the opening he had made. He had come upon the miser's modest little hoard, which amounted to two thousand francs, or £80. It was not a large sum, but it represented on the part of the poor woman the miserly savings of years.

NEW READING TESTS.—Standard III.

Suitable for 'Unseen Tests' in Dictation also.

282.—Cattle are great victims to the ravages of vampires, which often reduce them to a mere mass of skin and bone by the frequency of their attacks. The wound is usually inflicted upon the flanks of the animal, just where the teeth or feet of the victim cannot reach it; and in cases where there is pressure from harness or other causes often leads to considerable damage.

283.—A small girl of three years suddenly burst out crying at the dinner-table. 'Why, Ethel,' said her mother, 'what is the matter?' 'Oh,' whined Ethel, 'my teeth stepped on my tongue.'

284.—A shopkeeper purchased of an Irishwoman a quantity of butter, the lumps of which, intended for pounds, he weighed in the balance and found wanting. 'Sure, its your own fault if they are light,' said Biddy in reply to the complaints of the buyer. 'It's your own fault, sir, for wasn't it with a pound of your own soap I bought here that I weighed them?'

285.—In the days when highwaymen, as the robbers that usually rode on horseback were called, were common in England, an amusing encounter took place between one of these rascals and a poor tailor. The latter being bidden to 'stand and deliver' thought it wisest to do as he was told, particularly when the order was backed up with a couple of pistols presented at his head.

286.—A spider once invented a balloon for her babies to travel in. She seemed to have grown tired of her old home, and wanted to take her babies to a new one; so she spun a little gossamer balloon, shaped something like the half of a walnut-shell. She fastened it to the branch of a tree till all was ready. When she and her babies got into it, they clung all about her as though they were frightened.

287.—There was a curious chair in common use up to the seventeenth century. This was called the 'cucking-stool,' and was a kind of chair used for the punishment of scolding women, dishonest tradesmen, and similar purposes. The culprit was placed securely in the chair, there to be hooted at and pelted by the mob.

288.—A dear little girl aged three years was taken to church for the first time by her nurse. On their arrival at the church door they were met by the verger. 'Would you like to come and sit by the organ, Miss?' said the man. 'Is there a monkey there?' instantly answered the child, 'because if there isn't, I'll stay here.'

289.—At the window of a small poor-looking house, overlooking the harbour, sat a small, lean, grey-headed man in a tattered leather apron, hammering away with might and main at the sole of a worn-out shoe. Beside him sat a pale slender boy, hardly bigger than a child, who was cutting out strips of leather with a dreamy *far-off* look in his large dark eyes.—(H.M.I.'s Test.)

290.—But they all felt that there must be another opening, because the air was not difficult to breathe, and everyone hoped to find the other entrance; but where it was, no one could determine. There were side passages also, and none of the party could tell whither they led. The end of the cavern seemed as far off as ever. At length the guide stopped.—(H.M.I.'s Test.)

291.—The land was a long way off, and pulling was very hard work. There was not much water and very few provisions in the boat, but, fortunately, all had had a good meal before quitting the ship. After a while the sailors became tired, and Mr. Smith and his elder sons tried, but the land did not appear much nearer when night came again with a chill south wind.—(H.M.I.'s Test.)

292.—A few minutes afterwards, a young woman walked quickly from the Palace grounds through a private door which could be opened by the gardener's key, and hurried to the river-side. No doubt she was expected there, for she stepped into a boat which was waiting, without saying a word, and the sailor pulled off silently and quickly to a vessel which was at anchor.—(H.M.I.'s Test.)

293.—The children at a Sunday-school not long since, being asked, among other questions, what bearing false witness against one's neighbour meant, a little girl replied: 'It is when nobody hasn't done nothing, and somebody goes and tells.'

294.—A Swiss watchmaker has invented a watch for the blind. A small peg is set in the middle of each figure. When the hour hand reaches a given hour, the peg for that hour drops. The owner, when he wants to know the time, finds which peg is down, and then counts back to twelve.

295.—Bees are believed by many to be good weather guides, being sluggish and inactive in the morning if the day is going to be wet, and active and lively if it is going to turn out bright and fine.

296.—

We cannot all be heroes,
  And thrill a hemisphere
With some great daring venture,
  Some deed that mocks at fear;
But we can fill a lifetime
  With kindly acts and true,
There's always noble service
  For noble souls to do.

NEW DICTATION TESTS.—STANDARD IV.

Suitable for 'Unseen Tests' in Reading also.

No. 284.

CHILDREN may teach us one enviable art, the *art of being happy*. Nature has given to them that useful power of accommodation to circumstances which compensates for so many external disadvantages, and it is only by judicious management that it is lost. Give him but a moderate portion of food and kindness, and the peasant child is happier than that of the prince. Free from artificial wants, unsated by indulgence, he can carve out felicity from a bit of hazel twig, or fish for it successfully in a puddle.

No. 285.

A BIG fellow who, it was said, could eat a whole sheep at a meal, was once brought before King James I. 'And what else,' inquired the king, 'can this big lout do more than other men?' 'Nothing,' was the reply of the king's attendants. 'Then hang him at once,' said the king, 'for 'tis a pity for any man to live who eats the share of twenty men and can do no more than one.'

No. 286.

A POOR shoemaker of Portsmouth was the originator of the well-known method of educating city arabs, and other very poor children. For twenty years before his death in 1839, he used to collect around him the ragged children of the district in which he lived, and teach them while he worked at his trade. He taught them for nothing, and his class was well attended. His success at length attracted general notice, and systematic effort was in due course made for the establishment of such schools in other towns throughout the kingdom.

No. 287.

A NOVEL experiment has been made on the Shropshire Union Canal. A small engine was placed on eighteen-inch rails along the side of the towing-path, and drew with ease several boats at the rate of seven miles an hour. If this combination of rail and canal is found practicable, the remarkable interest lately taken in the revival of our long-neglected canal system will receive a fresh impetus which bodes the railway companies no good.

No. 288.

ONE would not imagine that butterflies were a very nourishing article of diet, yet millions of them are eaten every year by the Australian aborigines. They congregate in vast quantities, and the natives secure them by kindling fires of damp wood, which smoke very much, and thus suffocate the little insects. Then they are gathered in baskets, baked, sifted to remove the wings, and finally pressed into cakes. A friend of mine, who, when in Australia, tasted some of this queer food, tells me that it was very nice.

No. 289.

CHILDREN'S questions are apt to be trying to those who are constantly with them. By taking a little trouble in answering a child's question, his education may be carried on without any effort or strain to himself. Some children have naturally inquiring minds, and to these an unanswered question is a source of irritation. If elders would put themselves in the children's places, they would be far more sympathetic than they often are.

No. 290.

THE British Museum contains many rare and beautiful snuff-boxes of the last century, plain and enamelled, made of horn, silver, and gold, simple and complicated, small and large. Curious materials were sometimes used in the manufacture of these boxes. Some sixty years ago potato snuff-boxes were in common use. They were made of potato pulp, which, mixed with some glutinous material, was pressed into moulds, dried, varnished, and slightly fired.

No. 291.

THE latest thing in the carriage yards of the Union Pacific Railway is an air-compressing machine which is used for cleaning the carriages. This it performs far more effectually than any amount of brushing, and with infinitely less labour. An ordinary garden hose with a nozzle is attached to the air-compressor, and when a cock is turned the air rushes from it with such force as to blow every particle of dust out of every cranny, and even out of the upholstery work.

No. 292.

EVERYONE who has handled an oyster-shell must have noticed the successive layers overlapping each other. These are termed shots, and each one marks a year's growth, so that by counting them the age of the oyster can be determined. Up to the time of its maturity—that is, when four years of age—the shots are regular and successive; but after that time they become irregular and are piled one upon another, so that the shell becomes bulky and thickened.

No. 293.

THERE is a spider in New Zealand that usually throws coils of his web about the head of his prey until the wretched victim is first blinded and then choked. In many unfrequented dark nooks of the jungle you come across most perfect skeletons of small birds caught in these terrible snares.

No. 294.

LAVENDER has suddenly appeared in South Australia, the plant springing up luxuriantly over a large area at Black Swamp in the south of the colony. At first the settlers thought the plant was a weed, but on finding out its true nature they resolved to cultivate lavender on a considerable scale, with the view of establishing a regular perfumery trade.

No. 295.

IT is much easier to coin silver and copper than gold. A bit of copper or silver lost, or a few blanks unaccounted for, do not make much difference, but the smallest loss of gold is a more or less serious matter. Even when the commoner metals are being minted, the men have to account for what is entrusted to them, and they stand on gratings that metal may not stick to their boots, and in certain parts of the money factory they are not allowed out from morning till night, their dinners being brought to them.

No. 296.

NO man who has reached the age of threescore years and ten would, upon reflection, be willing to rub out from his experience in life the sorrows which have softened his character, the mistakes which have taught him wisdom, or the wrong doings which he has ever regretted, and which, by their influences, have made the golden threads which it is reasonable to suppose have been formed in the texture of his moral character.

No. 297.

ONE of the most remarkable things about the Inland Postal Service is the travelling post-office. This is a railway carriage fitted up as a post-office, and attached to fast trains on the main lines of railways. Into this are thrown all letters intended for places on the line which reached the post-office too late for classification. As the train speeds along the letters are sorted by a staff of clerks, sealed up in bags, and delivered at the various stations, being thrown off sometimes when the train is going at full speed.

No. 298.

EVERYBODY in London knows the Bluecoat Boys, with their odd, old-fashioned uniform of blue and yellow, lightened by silver buttons, and nothing whatever in the shape of a hat. Strangers always look at them with great interest, ask what they are, and, having found out, pay a visit to Christ's Hospital School, and walk over as much of that interesting and ancient pile as the gatekeeper, with the black top hat with the silver-lace band, will permit.

No. 299.

THE atmosphere of a house is what makes it homelike. Every living creature has an atmosphere of his own. He can be as chilly and damp and disagreeable as a March wind; he can be as bright, cheerful, and charming as a June morning; he can be as dark and impenetrable as a November fog, or as crisp and electric as a day in December. It depends entirely on ourselves whether we are ugly, cross, tyrannical, fretful, nagging, sulking, and unbearable, or kind, considerate, tender, thoughtful, cheery, sweet, and wholesome.

No. 300.

WHEN a Chinese emperor dies, the intelligence is announced by despatches to the several provinces, written with blue ink, the mourning colour. All persons of rank are required to take red silk ornaments from their caps with the ball or button of rank; all subjects of China, without exception, are called upon to forbear shaving their heads for 100 days, within which period none may marry, play upon musical instruments, or perform any sacrifice.

No. 301.

AN illustration of the curious effects of panic is furnished by the recent run on the Penny Bank. Someone started the ridiculous rumour that the Duke of Westminster had lost all his money by betting, and then set in a rush of thousands of poor depositors, who carried off their hard-earned savings in their pockets, in their handkerchiefs—in anything. It is an ill wind that blows nobody good, and I am sorry to say that the gin-palaces in the neighbourhood did a roaring trade out of the flush pockets of their unexpected customers. (H. M. I.'s Test.)

No. 302.

IT may be that there are times when we deserve rewards and punishments, and have them meted out to us; or it may be that waves of woe sweep through the universe at times, and whirl with them the man who happens to be standing in their way; but that one trial follows on another's heels, and one joy comes smiling up as another passes, is the experience of every living soul who takes heed of his own life-story.

No. 303.

A NEW use has been found for diamonds, in assisting marksmen in their shooting. The cut stones are fixed in the front and back sights, and it is said that they enable the gunner to take a quick and correct aim, even when the light is bad. The brilliants are so fitted that as soon as the gun is brought to the shoulder, the eye takes aim without the least hesitation.

No. 304.

EASE signifies waste power, or, at least, strength unused. Generally, he who does anything easily is doing less than his best. Until we feel the burden of overcoming a difficulty, we do not know that we are doing as we might do. It were better to have it said that you write well than that you write easily; for though you may write well with comparative ease, it would be a greater glory to write better under difficulties.

No. 305.

THE opossum is a pouched animal belonging to the same class as the kangaroo, and, like it, found in Australia. These creatures are sometimes hunted, but as the chase takes place at night, it is often difficult to get at them. They are thus usually pursued by moonlight. They will then be in the trees feeding, or if on the ground, will take to the trees at once on the hint of danger. It is not easy to see them unless the hunters have had much experience. By gradually searching the tree all over he will probably at length sight an opossum crouching on a branch with its ears pricked up and on the alert.

No. 306.

EVERY bee carries his market basket round his hind legs. Any one examining the body of a bee through a microscope will observe that on the hind legs of the creature there is a fringe of stiff hairs on the surface, the hairs approaching each other at the tips so as to form a sort of cage. This is the bee's basket, and into it, after a successful journey, he will cram enough pollen to last him for two or three days. Every one has seen a bee returning home with a little yellow lump on his hind leg, and if the insect is then examined, the form of the basket can be easily seen.

No. 307.

There are truths too sublime and too holy,
To grasp with a mortal mind's touch;
We are happier far to be lowly,
Content means not knowing too much.
Peace dwells not with hearts that are yearning
To fathom all labyrinths unguessed,
And the soul that is bent on vast learning
Shall find with its knowledge—unrest.

STANDARDS V.—VII., AND 1ST & 2ND YEAR P.T's.

Suitable for 'Unseen Tests' in Reading also.

No. 260.

PEOPLE who are unfortunate enough to live in damp houses, particularly near undrained land, are apt to think that there is no help for them save in removal. They are mistaken. Successful experiments have shown that it is quite possible to materially improve the atmosphere in such neighbourhoods in a very simple manner—by the planting of the laurel and the sunflower. The laurel gives off an abundance of ozone, whilst the sunflower is potent in destroying the malarial condition. These two, if planted on the most restricted scale in a garden close to the house, will be found to speedily increase the dryness and salubrity of the atmosphere, and rheumatism, if it does not entirely become a memory of the past, will be largely alleviated.

No. 261.

CAPE Colony has deservedly been termed the 'Paradise of Flowers.' Not only are they gay in themselves, but they also bloom at different seasons in the different parts of the colony; hence one can roam, all the year round, amongst a glorious array of flowers. The first shower, after a dry season, brings up, as if by magic, hundreds of bulbous and tuberous plants belonging to the lily, snowdrop, crocus, and orchid family, with flowers of scarlet, rose, gold, or orange. There, too, abound flowers of many colours; and numerous species of pelargonium, whence have sprung the varieties known in English gardens as white, pink, or scarlet geraniums. There the earth is cushioned by four hundred distinct sorts of heath, many of which are cultivated in English conservatories.

No. 262.

WANT of sleep is engendered by too great activity of the brain at night. Many people say that night is their best time for work, and thus spend the early part of the day, when the brain is freshest, in idleness, and at night do their work. Working the brain until just before retiring to rest is with many fatal to a good night's rest. The over-wrought and tired brain cannot throw off the thoughts caused by the work, and on lying down in bed they return with what seems greater intensity, and thus sleep is dispelled. It is a good plan to stop brain work at a fixed hour before retiring, and then indulge in some recreation in the way of games or light reading, such as newspapers, magazines, etc.

No. 263.

VARIETY in work is true recreation, and without it no one can long continue healthy or in good spirits. This fact is well understood by many busy people, who so arrange their work that no one pursuit is allowed to monopolise more than a reasonable part of each day. Not only, though, is change of work essential, but a proper provision for recreation will be made by those who desire to enjoy the perfection of happiness. There is no sadder sight than that of a person who, having worked hard all his life in one narrow groove, finds, when the necessity for work is over, that he has no resource, and must continue that work or suffer perfect boredom. It is well, therefore, for all busy, hard-working people to *cultivate* a hobby, if they have not a natural liking for any particular pursuit, which will absorb their few spare hours of recreation.

No. 264.

THE brave old oak has for years untold been the pride and glory of our country; it has built the ships which have carried us to victory; it has given a quiet grandeur to the ceilings, walls, and floors of our castles and country-houses, which none of the curious devices of modern æsthetic taste can surpass; it has sheltered our villages with its wide-spreading canopy in storm and shine; it has braved the centuries' hurricanes, and though its bole may have been riven and blackened a thousand times by the lightning's flash, it has preserved its vitality in defiance of all adverse elements, still putting forth the green leaf.

No. 265.

IT may not be generally known that a telegraphist always travels by 'royal trains.' In case of any mishap a ladder is placed against the nearest telegraph-post, and a wire tied—or connected—with an instrument which the telegraph clerk works, sitting on the bank. By this means, word can be at once sent to the nearest railway station giving instructions that assistance must be sent immediately to such and such a spot. When a train with the sovereign on board is travelling, all the men in responsible positions along the line are forewarned. Once on the Brighton line a trial was made. The royal train was stopped, and the telegraphist sent word in the way just described. The result was most satisfactory, and the royal person was well pleased at the promptitude with which a relief party arrived from a place some miles distant.

No. 266.

THERE are two lives to each of us, gliding on at the same time, scarcely connected with each other—the life of our actions, the life of our minds; the external and internal history; the movements of the frame, the deep and ever-restless workings of the heart! They who have loved know that there is a diary of the affections, which we might keep for years without having occasion even to touch upon the exterior surface of life, our busy occupations—the mechanical progress of our existence; yet by the last are we judged.

the first is never known. History reveals men's deeds, men's outward characters, but *not themselves.*

No. 267.

SCIENCE discloses gardens of delight, where the imagination may range unfettered, its loftiest flights outdone by the realities of the mysterious and wonderful universe. Literature builds, for rich and poor, palaces of beauty, stored with wondrous imagery, where truth builds up right principle, and virtue inspires to noble deeds. And from the remotest corners of the earth the daily press brings, to the cottage door and the palace alike, tidings of the doings, thinkings, and sayings of far-away peoples, which cannot but have an effect in widening the sympathies of men, and drawing the nations closer together.

No. 268.

FEW attributes of character are more charming than the faculty of gracefully acknowledging one's errors. The man who makes a blunder and sticks to it is a person with whom argument or controversy becomes impossible. The trouble and time spent in attempting to convince him of the truth are completely wasted, for he will still believe that what he has advanced must be right, even in the face of actual demonstration that it is wrong. On the other hand, of the action of one who will admit with frank and ready courtesy that he has been mistaken, it may be said that it 'blesseth him that gives and him that takes'—it covers his own retreat with gracefulness, and gives his adversary a pleasant memory of an encounter with a generous foe.

No. 269.

THE best recipe we know, if you want to be miserable, is to think about yourself—how much you have lost, how much you have not made, and the poor prospects for the future. A brave man with a soul in him gets out of such pitiful ruts and laughs at discouragements, rolls up his sleeves, whistles and sings, and makes the best of life. This earth was never intended for a paradise, and a man who rises above his discouragements and keeps his manhood will be only the stronger and better for his adversities. Many a noble ship has been saved by throwing overboard its most valuable cargo, and many a man is better and more humane after he has lost his gold.

No. 270.

ONE of the surest ways to make children good and useful men and women is to give them a profession or trade, something that will engage their thoughts and hands. It is becoming more and more the rule, and not the exception, for a girl to study for a life's work. If she is ever a wife and mother she will be all the better fitted for her mission if she has learned to do some special work well and faithfully. However wealthy parents are, they do a positive wrong when they fail to educate their daughters and sons so that they can become self-supporting and self-respecting. It is of double importance that the daughter should be provided with means to obtain her livelihood against a time when by sudden reverse of fortune even the garnered wealth of generations may be suddenly swept away.

No. 271.

A FRENCHMAN is now exhibiting at Paris a collection of 250 performing rats, who work a miniature railway train. He claims to have made a special study of these animals, whom he describes as the most impressionable of beasts and the most inclined to melancholy by reason of their fragile, nervous organization. Extremes of heat and cold alike affect them, and every day he has to turn them loose into an empty chamber for a couple of hours, otherwise they would soon go mad. His animals have been taught to take their places in the miniature railway train by the simple process of putting their food on the engine and in the carriages till they have been accustomed to go there whenever the train appears.

No. 272.

AN important lesson is that of patience. A man must learn to wait as well as to work, and to be content with those means of advancement in life which he may use with integrity and honour. Patience is one of the most difficult lessons to learn. It is natural for the mind to look for immediate results. Let this, then, be understood at starting: that the patient conquest of difficulties which rise in the regular and legitimate channels of business and enterprise is not only essential in securing the success which a young man seeks in life, but essential, also, to that preparation of the mind requisite for the enjoyment of success, and for retaining it when gained. It is the general rule in all the world and in all time, that unearned success is a curse.

No. 273.

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How silent is the air!
Who would not at such shrine
To holier thoughts incline?
The ever tranquil Night was made for prayer.
On the hush'd Earth, from the o'er-arching sky,
Doth not a solemn benediction lie?
And when the hours of night
Have slowly roll'd away,
And the victorious Day
Athwart the kindling air speeds arrowy light,
How gloriously, as in a second birth,
Awake to radiant life the heavens and earth!

No. 301.

AN illustration of the curious effects of panic is furnished by the recent run on the Penny Bank. Someone started the ridiculous rumour that the Duke of Westminster had lost all his money by betting, and then set in a rush of thousands of poor depositors, who carried off their hard-earned savings in their pockets, in their handkerchiefs—in anything. It is an ill wind that blows nobody good, and I am sorry to say that the gin-palaces in the neighbourhood did a roaring trade out of the flush pockets of their unexpected customers. (H.M.I.'s Test.)

No. 302.

IT may be that there are times when we deserve rewards and punishments, and have them meted out to us; or it may be that waves of woe sweep through the universe at times, and whirl with them the man who happens to be standing in their way; but that one trial follows on another's heels, and one joy comes smiling up as another passes, is the experience of every living soul who takes heed of his own life-story.

No. 303.

A NEW use has been found for diamonds, in assisting marksmen in their shooting. The cut stones are fixed in the front and back sights, and it is said that they enable the gunner to take a quick and correct aim, even when the light is bad. The brilliants are so fitted that as soon as the gun is brought to the shoulder, the eye takes aim without the least hesitation.

No. 304.

EASE signifies waste power, or, at least, strength unused. Generally, he who does anything easily is doing less than his best. Until we feel the burden of overcoming a difficulty, we do not know that we are doing as we might do. It were better to have it said that you write well than that you write easily; for though you may write well with comparative ease, it would be a greater glory to write better under difficulties.

No. 305.

THE opossum is a pouched animal belonging to the same class as the kangaroo, and, like it, found in Australia. These creatures are sometimes hunted, but as the chase takes place at night, it is often difficult to get at them. They are thus usually pursued by moonlight. They will then be in the trees feeding, or if on the ground, will take to the trees at once on the hint of danger. It is not easy to see them unless the hunters have had much experience. By gradually searching the tree all over he will probably at length sight an opossum crouching on a branch with its ears pricked up and on the alert.

No. 306.

EVERY bee carries his market basket round his hind legs. Any one examining the body of a bee through a microscope will observe that on the hind legs of the creature there is a fringe of stiff hairs on the surface, the hairs approaching each other at the tips so as to form a sort of cage. This is the bee's basket, and into it, after a successful journey, he will cram enough pollen to last him for two or three days. Every one has seen a bee returning home with a little yellow lump on his hind leg, and if the insect is then examined, the form of the basket can be easily seen.

No. 307.

There are truths too sublime and too holy,
To grasp with a mortal mind's touch;
We are happier far to be lowly,
Content means not knowing too much.
Peace dwells not with hearts that are yearning
To fathom all labyrinths unguessed,
And the soul that is bent on vast learning
Shall find with its knowledge—unrest.

STANDARDS V.—VII., AND 1ST & 2ND YEAR P.T's.

Suitable for 'Unseen Tests' in Reading also.

No. 260.

PEOPLE who are unfortunate enough to live in damp houses, particularly near undrained land, are apt to think that there is no help for them save in removal. They are mistaken. Successful experiments have shown that it is quite possible to materially improve the atmosphere in such neighbourhoods in a very simple manner—by the planting of the laurel and the sunflower. The laurel gives off an abundance of ozone, whilst the sunflower is potent in destroying the malarial condition. These two, if planted on the most restricted scale in a garden close to the house, will be found to speedily increase the dryness and salubrity of the atmosphere, and rheumatism, if it does not entirely become a memory of the past, will be largely alleviated.

No. 261.

CAPE Colony has deservedly been termed the 'Paradise of Flowers.' Not only are they gay in themselves, but they also bloom at different seasons in the different parts of the colony; hence one can roam, all the year round, amongst a glorious array of flowers. The first shower, after a dry season, brings up, as if by magic, hundreds of bulbous and tuberous plants belonging to the lily, snowdrop, crocus, and orchid family, with flowers of scarlet, rose, gold, or orange. There, too, abound flowers of many colours; and numerous species of pelargonium, whence have sprung the varieties known in English gardens as white, pink, or scarlet geraniums. There the earth is cushioned by four hundred distinct sorts of heath, many of which are cultivated in English conservatories.

No. 262.

WANT of sleep is engendered by too great activity of the brain at night. Many people say that night is their best time for work, and thus spend the early part of the day, when the brain is freshest, in idleness, and at night do their work. Working the brain until just before retiring to rest is with many fatal to a good night's rest. The over-wrought and tired brain cannot throw off the thoughts caused by the work, and on lying down in bed they return with what seems greater intensity, and thus sleep is dispelled. It is a good plan to stop brain work at a fixed hour before retiring, and then indulge in some recreation in the way of games or light reading, such as newspapers, magazines, etc.

No. 263.

VARIETY in work is true recreation, and without it no one can long continue healthy or in good spirits. This fact is well understood by many busy people, who so arrange their work that no one pursuit is allowed to monopolise more than a reasonable part of each day. Not only, though, is change of work essential, but a proper provision for recreation will be made by those who desire to enjoy the perfection of happiness. There is no sadder sight than that of a person who, having worked hard all his life in one narrow groove, finds, when the necessity for work is over, that he has no resource, and must continue that work or suffer perfect boredom. It is well, therefore, for all busy, hard-working people to *cultivate* a hobby, if they have not a natural liking for any particular pursuit, which will absorb their few spare hours of recreation.

No. 264.

THE brave old oak has for years untold been the pride and glory of our country; it has built the ships which have carried us to victory; it has given a quiet grandeur to the ceilings, walls, and floors of our castles and country-houses, which none of the curious devices of modern æsthetic taste can surpass; it has sheltered our villages with its wide-spreading canopy in storm and shine; it has braved the centuries' hurricanes, and though its bole may have been riven and blackened a thousand times by the lightning's flash, it has preserved its vitality in defiance of all adverse elements, still putting forth the green leaf.

No. 265.

IT may not be generally known that a telegraphist always travels by 'royal trains.' In case of any mishap a ladder is placed against the nearest telegraph-post, and a wire tied—or connected—with an instrument which the telegraph clerk works, sitting on the bank. By this means, word can be at once sent to the nearest railway station giving instructions that assistance must be sent immediately to such and such a spot. When a train with the sovereign on board is travelling, all the men in responsible positions along the line are forewarned. Once on the Brighton line a trial was made. The royal train was stopped, and the telegraphist sent word in the way just described. The result was most satisfactory, and the royal person was well pleased at the promptitude with which a relief party arrived from a place some miles distant.

No. 266.

THERE are two lives to each of us, gliding on at the same time, scarcely connected with each other—the life of our actions, the life of our minds; the external and internal history; the movements of the frame, the deep and ever-restless workings of the heart! They who have loved know that there is a diary of the affections, which we might keep for years without having occasion even to touch upon the exterior surface of life, our busy occupations—the mechanical progress of our existence; yet by the last are we judged.

the first is never known. History reveals men's deeds, men's outward characters, but *not themselves*.

No. 267.

SCIENCE discloses gardens of delight, where the imagination may range unfettered, its loftiest flights outdone by the realities of the mysterious and wonderful universe. Literature builds, for rich and poor, palaces of beauty, stored with wondrous imagery, where truth builds up right principle, and virtue inspires to noble deeds. And from the remotest corners of the earth the daily press brings, to the cottage door and the palace alike, tidings of the doings, thinkings, and sayings of far-away peoples, which cannot but have an effect in widening the sympathies of men, and drawing the nations closer together.

No. 268.

FEW attributes of character are more charming than the faculty of gracefully acknowledging one's errors. The man who makes a blunder and sticks to it is a person with whom argument or controversy becomes impossible. The trouble and time spent in attempting to convince him of the truth are completely wasted, for he will still believe that what he has advanced must be right, even in the face of actual demonstration that it is wrong. On the other hand, of the action of one who will admit with frank and ready courtesy that he has been mistaken, it may be said that it 'blesseth him that gives and him that takes'—it covers his own retreat with gracefulness, and gives his adversary a pleasant memory of an encounter with a generous foe.

No. 269.

THE best recipe we know, if you want to be miserable, is to think about yourself—how much you have lost, how much you have not made, and the poor prospects for the future. A brave man with a soul in him gets out of such pitiful ruts and laughs at discouragements, rolls up his sleeves, whistles and sings, and makes the best of life. This earth was never intended for a paradise, and a man who rises above his discouragements and keeps his manhood will be only the stronger and better for his adversities. Many a noble ship has been saved by throwing overboard its most valuable cargo, and many a man is better and more humane after he has lost his gold.

No. 270.

ONE of the surest ways to make children good and useful men and women is to give them a profession or trade, something that will engage their thoughts and hands. It is becoming more and more the rule, and not the exception, for a girl to study for a life's work. If she is ever a wife and mother she will be all the better fitted for her mission if she has learned to do some special work well and faithfully. However wealthy parents are, they do a positive wrong when they fail to educate their daughters and sons so that they can become self-supporting and self-respecting. It is of double importance that the daughter should be provided with means to obtain her livelihood against a time when by sudden reverse of fortune even the garnered wealth of generations may be suddenly swept away.

No. 271.

A FRENCHMAN is now exhibiting at Paris a collection of 250 performing rats, who work a miniature railway train. He claims to have made a special study of these animals, whom he describes as the most impressionable of beasts and the most inclined to melancholy by reason of their fragile, nervous organization. Extremes of heat and cold alike affect them, and every day he has to turn them loose into an empty chamber for a couple of hours, otherwise they would soon go mad. His animals have been taught to take their places in the miniature railway train by the simple process of putting their food on the engine and in the carriages till they have been accustomed to go there whenever the train appears.

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Awake to radiant life the heavens and earth!

COMPOSITION TESTS.—STANDARDS VI. & VII. AND 1ST & 2ND YEAR P.T.'S.

Write at least 20 lines on ONE of the following :—

103. The contents of your School Museum.

104. Letter to your Father showing him how far the possessions of our Colonies is a source of strength or weakness to the mother country.

105. Mention the different uses to which electricity is applied, and describe one in particular.

106. Write a letter to your Aunt describing the longest railway journey you have ever made.

107. In a letter to your Cousin, tell him why farming in England is less profitable than it used to be.

108. Describe your favourite outdoor pastime in summer and your indoor amusement in winter.

109. The life of any exemplary public character you are acquainted with.

110. Advantages and disadvantages of town life as compared with life in the country.

111. Two ways in which you would spend a holiday.

112. A letter to your Uncle on Gardening ; A Storm at Sea ; OR A Day's Angling.

NEW PROBLEMS IN ARITHMETIC.

(SECOND SERIES.)

BY T. B. ELLERY, F.R.G.S.,
President of the National Union of Teachers.

6TH PAPER.

STANDARD I.—(1895 CODE).

THE first series having been well received, and the Editor's wish being law, the present series is submitted in the hope that teachers—especially the young and inexperienced—may derive some assistance in their heavy labours.

As I have said before, a number of the exercises may be found beyond some of the children in the Standard, but each will form the basis of a good lesson, and the whole set, carefully worked on the blackboard and by the children, will give excellent practice and help considerably in the preparation for more advanced work.

For introduction see *The Practical Teacher* for October 1894, and for further particulars *The Girls' Mistress* for September 1st, 1894, in which issue appeared the first of a series of papers entitled *Standard Problems for Girls, and How to Solve them.*

The second series began with a set of tests for Standard III.

A.

1. I gave away 16 apples, then 28, then 19, then half-a-dozen, and I had 14 for myself. How many had I at first ?

2. Add 18, 35, 16, and 90, and take twice ten from your answer.

3. Take 38 from 200, and then take 163 from 310, and add your two answers.

4. What is the difference between (118 + 56 + 94) and (99 + 316 + 8) ?

5. A man bought 80 pears. He gave sixteen to one man and eight to another. How many left ?

6. How many legs in all have eight men, six cows, and ten sheep ?

7. There are six desks, each with eight boys, and there are twelve other boys standing. How many boys altogether ?

8. A farmer had four hundred sheep in four fields. In one field he had ninety-six, in another one hundred and three, and in another eighty-six. How many had he in the fourth field ?

9. After giving sixty apples to one woman, fifty-two to another, and forty-eight to another, I had six dozen left. How many had I at first ?

10. I bought 88 buns, then 120, and then thirty-five. I gave away nineteen. How many left ?

11. Add 58 and 69, and then add your answer to the difference between 100 and 18.

12. I had two hundred nuts. I gave 8 to Sam, and half that number to Fred. How many left ?

B.

13. When all are present there are 65 boys in a certain class. One morning 6 boys are absent and 7 late. How many are early ?

14. If 36 boys have a penny each, and 24 boys have twopence each, how many pennies have they in all ?

15. If I give 6 nuts to Harry, 7 to Fred, and 4 to Tom, how many shall I still have out of a hundred ?

16. There are 40 boys in class 1, 50 boys in class 2, and 65 boys in class 3. How many boys must there be in class 4 to make 200 in all ?

17. Tom bought 80 marbles, and then 45 more. He lost 2 dozen. How many had he then ?

18. My brother had 36 nuts. He gave 8 to each of three boys. How many had he then ?

19. A girl had sixteen pins in one packet, twenty-four in another, and fifty in another. She gave away 36. How many had she then ?

20. I have four baskets holding altogether one hundred and fifty apples. In the first there are 35, in the second 45, and in the third three dozen. How many in the fourth ?

21. John has 6 pennies in one pocket, and four times that number in another pocket. How many pennies has he altogether ?

22. I had 35 buns, William had two more than that number, and Harry had 44. How many had they in all ?

23. I had six pennies in each of 4 bags and four pennies in each of two pockets. How many had I altogether ?

24. A farmer had 250 sheep in a field. He sold 90 of them, and then he bought a dozen more. How many had he then ?

C.

25. A man gave 45 nuts to each of two boys, and 35 to each of two girls. How many did he give away in all ?

26. Fred had fifty-four nuts, and he bought thirty-six more. He sold 18, and gave away twenty-five. How many had he then ?

27. I wanted to give sixteen nuts to each of two boys and a girl, but I had only thirty-eight. How many had I to buy ?

28. I had forty-eight nuts. I gave forty to my son, and divided the rest equally between two boys. How many did each receive?

29. Five boys had 5 pens each, and four others had 3 pens each. How many more than three dozen had they?

30. Tom had one hundred and twenty apples, and I had eighty-eight. A man gave me fifty-four more. How many had I then more than Tom?

31. I bought eight apples at two a penny, and fifteen apples at three a penny. How many pennies did I spend in all?

32. How many *twos* are there in the difference between fifty-six and eighty?

33. A farmer had six hundred and twenty sheep. He sold 185 to one man, and ten more than that number to another man. How many had he then?

34. I have two baskets in each of which are sixty-six oranges, and three baskets in each of which are eighty-four oranges. How many oranges have I altogether?

35. I give eighteen pounds for a horse and twenty pounds for a cow. What shall I pay in all for two horses and two cows?

36. A man gave five apples to each of three boys and two girls, and had sixty-five left. How many had he at first?

37. Mary had one hundred and eight needles, Emily ninety-two, and Rose eighty-four. A lady gave six to each of them. How many had they altogether then?

38. A man had a hundred and sixty oranges. He gave eighteen to each of two boys, twenty-four to each of three girls, and he gave six to each of his two sons. How many had he then?

39. Tom had sixty-four pears, William 52, and Walter 44. William gave six to Tom and eight to Walter. How many had Tom and Walter together then?

40. I had a hundred and eighty cherries, and Fred had a hundred and thirty cherries. I gave Fred fifty-six. How many had he then more than I?

ANSWERS.

(1) 83 apples.
(2) 139.
(3) 309.
(4) 155.
(5) 56 pears.
(6) 80 legs.
(7) 60 boys.
(8) 115 sheep.
(9) 232 apples.
(10) 224 buns.
(11) 209.
(12) 188 nuts.
(13) 52 boys early.
(14) 84 pennies.
(15) 83 nuts left.
(16) 45 boys in class 4.
(17) 101 marbles.
(18) 12 nuts.
(19) 54 pins.
(20) 34 apples.
(21) 30 pennies.
(22) 116 buns.
(23) 32 pennies.
(24) 172 sheep.
(25) 160 nuts.
(26) 47 nuts.
(27) 10 nuts.
(28) 4 nuts each.
(29) 1 more.
(30) 22 apples more.
(31) 9 pennies.
(32) 12 twos.
(33) 240 sheep left.
(34) 384 oranges.
(35) 76 pounds.
(36) 90 apples.
(37) 302 needles.
(38) 40 oranges.
(39) 122 pears.
(40) 62 cherries.

MENTAL ARITHMETIC FOR THE STANDARDS.

BY T. B. ELLERY, F.R.G.S.,
President of the National Union of Teachers.

'*Mental work will strengthen the power of computation, and facilitate the handling of simple problems.*'—MR. CODD, H.M.I.S.

Fourth Paper.

STANDARD I.—*Continued.*

IT may not be out of place, perhaps, to introduce at this stage a few extracts from the Inspectors' latest reports bearing on mental arithmetic:—

'Mental arithmetic is one of the most useful exercises. It is, however, not so much neglected as it used to be, but it is not made sufficiently interesting to the children, and in many schools not only the infants but even the children in the upper standards still count on their fingers. More concrete teaching is wanted.'

'In some schools mental arithmetic is now satisfactory, but in others it remains weak year after year, and we are reluctantly driven to the conclusion that the fault is not with the children.'

'Another common defect is the want of due attention to mental arithmetic, *i.e.*, the training of the scholars by easy and gradual steps to make calculations mentally. If this mental training preceded the working of sums, the latter would be done much more readily and intelligently, and without resorting to mechanical aids, or requiring such an enormous amount of marginal work as one often sees on the examination papers. And here, in passing, I wish to animadvert on the very common practice of setting for young children sums or questions in addition or subtraction which involve steps that are far too difficult for them, as for example 9 + 7, when the child can hardly do 3 + 2.'

'Arithmetic is not, as a rule, introduced so simply and gradually as it ought to be, and young children are asked to add and subtract numbers mentally, and to work sums on slate, before they have been sufficiently prepared for such work, and the result is that they are driven to count on their fingers or with strokes on their slates—a habit which is difficult afterwards to eradicate.'

'Mental arithmetic is made too much an afterthought and supplement rather than the introduction to the working of sums.'

'Mental arithmetic has a good effect on the children; "A little and often" should be the teacher's motto; always to leave off while the interest is keen. The desire to excel is strong, and children exert themselves to answer quickly. These oral problems bring home "the reason why" in working sums.'

In our last paper we reached the number 50. I propose now to go on to 100, once more, however, reminding my readers that in the limits of short papers it is impossible to treat each step as fully as I should like to treat it. Much must be left to the teacher.

And, first, let the children proceed from 50 to 60:—

5 times 11 is 55	6 times 9 is 54
5 „ 12 „ 60	6 „ 10 „ 60

	s.	d.		£	s.	d.
50 pence is	4	2	50 shillings is	2	10	0
51 „	4	3	51 „	2	11	0
to			to			
60 „	5	0	60 „	3	0	0

Repeat: 5 times 11 is 55 = 4 7 6 times 9 is 54 = 4 6 and so on, but use actual coins, if possible, by way of introduction.

Keep the *tens* well in hand. 10 + 10 = 20; 20 + 20 = 40; 30 + 10 = 40; 30 + 20 = 50; 30 + 30 = 60.

Twice 10 is 20; twice 20 is 40; twice 30 is 60; three times 10 is 30; three times 20 is 60.

Show how 60, for example, is 'built up.' 3 twenties; 6 tens; 5 twelves; etc.

Introduce *fives*. 35 + 5 = 40; 45 + 5 = 50; 55 + 5 = 60.

Then, 45 + 5 = 50; 45 + 10 = 55; 45 + 15 = 60; 15 + 15 = 30; 15 + 15 + 15 = 45; 15 + 15 + 15 + 15 = 60.

Then, there are two fifteens in 30, three fifteens in 45, and four fifteens in 60.

1. Add 8, 10, 12, 20.

2. Take 35 from 55; 45 from 60.

3. I have 5 dozen apples. I give 10 to one boy and 20 to another. How many left?

4. How many must you add to 48 to make 60? (Note, 48 from 50 is 2.)

5. Take four times 12 from five times 11.

6. 50 pence? 55 pence? 59 pence?

7. What must you add to 54 pence to make 5s.?

8. How many farthings are there in a penny? In a shilling?

9. Take 3s. 6d. from 5s.

10. How many sixpences in 4s.? In 5s?

11. How many threepences in 1s.? In 2s. 6d.? In 3s. 6d? In 4s. 6d.?

12. Take 3s. 11½d. from 4s., and from 5s.

13. I gave twenty apples to each of two boys, and had ten left. How many had I at first?

14. By how much does 5 times 12 exceed 4 times 10?

15. How many fives in 35? In 45? In 55?

16. A farmer had 24 cows in one field and 20 in another. How many more to make 50? to make 60?

17. Add 19, 19, and 19. (Note, 3 twenties − 3.)

18. A boy had 60 nuts. He gave 5 to each of 7 boys. How many left? (35 from 40 first.)

19. By how much does 5 × 11 exceed 4 × 10? By how much does 6 × 9 exceed 4 × 12?

20. I gave 4 nuts to each of 8 boys, and 5 nuts to each of 4 boys. I had 5 dozen at first. How many left? (32 + 20 = 52; 2 from 10 is 8; 52 from 60 is 8.)

To 70 *and* 80.

	s.	d.		s.	d.
6 times 11 is 66 =	5	6			
60 pence =	5	0	60 pence is	5	0
61 „ =	5	1	66 „	5	6
to			63 „	5	3
70 „ =	5	10	69 „	5	9

60 + 5 = 65 60 + 10 = 70
50 + 10 = 60 50 + 20 = 70
50 + 15 = 65 55 + 10 = 65
55 + 15 = 70

70 − 5 = 65; 70 − 10 = 60; 70 − 15 = 55; 70 − 25 = 45; 70 − 35 = 35; and so on.

Again, 5s. 10d. − 10d. = 5s.; 5s. 10d. − 1s. = 4s. 10d.

So 4s. 10d. + 2d. = 5s.; 3s. 10d. + 1s. 2d. = 5s.; 3s. 6d. + 2s. = 5s. 6d.; 2s. 6d. + 2s. 4d. = 4s. 10d.; 3s. 6d. + 2s. 4d. = 5s. 10d., etc., etc.

Similarly to 80.

	s.	d.		s.	d.
71 pence =	5	11	6 times 12 is 72 =	6	0
72 „ =	6	0			
to					
80 „ =	6	8			

60 + 10 = 70; 60 + 20 = 80; 50 + 30 = 80; 40 + 40 = 80; 60 + 20 = 80.

Twice twenty is 40; twice forty is 80.

Four tens = 40; four twenties = 80.

50 from 80 = 30; 75 from 80 = 5; 65 from 80 = 15; 55 from 80 = 25.

The half of 60 is 30; the half of 80 is 40; the half of 70 is 35. (35 + 35 = 70.) The fourth of 80 is 20; the fourth of 60 is 15. (15 + 15 = 30.)

There are 80 pence in 6s. 8d.; there are 40 twopences is 6s. 8d. 20 fourpences in 6s. 8d. 3s. 4d. + 3s. 4d. is 6s. 8d. The half of 6s. 8d. is 3s. 4d. 48 pence = 4s. 60 pence = 5s. 72 pence = 6s.

21. How many shillings in 72 pence? in 79 pence?

22. Add 30, 20, 20, and 10.

23. By how much does 6 × 12 exceed 5 times 12?

24. Add two dozen to 5 times 10.

25. Take 5s. 6d. from 6s., and from 6s. 8d.

26. How many sixpences in 5s. 6d.? 6s. 6d.?

27. How many sixpences in the sum of 30 pence, 20 pence, and 22 pence?

28. How many apples can I buy with 3s., if I can buy 8 with 6d.?

29. How many oranges can I buy with 6s., at the rate of 5 for 6d.?

30. How many sixes are there in 60? in 72? in 78?

To 90 *and* 100.

	s.	d.		s.	d.
81 pence =	6	9	80 pence =	6	8
82 „ =	6	10	84 „ =	7	0
to			90 „ =	7	6
90 „ =	7	6.			

So with the pounds. 60s. = £3. 70s. = £3 10s. 80s. = £4. 90s. = £4 10s.

(In the multiplication and division tables we do not proceed beyond 6 times 12, that being the limit in Standard I. We do not, therefore, at present, take such exercises as 8 tens in 80; 9 tens in 90; but it will be well to introduce this as early as possible.)

80 + 10 = 90. The half of 80 is 40; the half of 10 is 5; the half of 90 is 45. 30 + 30 + 30 = 90. The *third* of 90 is 30.

We may deal with other numbers in the same way. The half of 80 is 40; the half of 4 is 2; The half of 84 is 42, and so on.

The fourth of 80 is 20; the fourth of 4 is 1.

The fourth of 84 is 21; and so on.

Similarly to 100.

	s.	d.		s.	d.
91 pence =	7	7	90 pence =	7	6
92 „ =	7	8	96 „ =	8	0
to			100 „ =	8	4
100 „ =	8	4.			

There are 10 sixpences in 5s. 12 in 6s. 18 in 9s. 3 twenties + 10 = 70. 4 twenties + 10 = 90. 5 twenties = 100. The half of 100 is 50; the fourth of 100 is 25. The third of 60 is 20; the third of 90 is 30; the third of 96 is 32; the third of 99 is 33. Many similar exercises may be given.

31. Take 90 from 100; 89 from 100.

32. What must you add to 81 to make 100?

33. What must I add to 90 pence to make 8s. 4d.? (100—90.)

34. I have 12 sixpences. How much more do I require to make 8s. 4d.?

35. Add 35, 5, 30, 25.

36. Take 6 times 12 from 80, from 90, and from 100.

37. Take 4s. 6d. from 8s.; 3s. 6d. from 7s.

38. What must you take from 8s. to leave 6s.? to leave 5s. 11d.?

39. 79 pence? 89 pence? 99 pence? (Note—80, 90, and 100 respectively.)

40. How many oranges at 20 for 6d. can I buy with 2s.? with 2s. 6d.?

41. I have in a box, 5 shillings, 5 sixpences, and a threepenny piece. How much have I altogether?

42. What must you add to 75 to make 80? to make 90? to make 95? to make 100?

43. How many half-dozens are there in 36? 54? 72?

44. How many pence in 7s.? 6s. 8d.? 8s. 3d.?

45. How many half-pence in 3s.? 3s. 6d.? 4s.?

46. Take 7s. 5½d. from 8s.; 6s. 11d. from 9s.

47. What must you add to 6 times eleven to make 80? to make 90? to make 96?

48. Add the fifth part of 60 to the fourth part of 40.

49. What is the half of the sum of 36, 10, 14, and 40?

50. If I earn 4 pence a day, how long shall I take to earn 2s.? 4s.? 5s.?

51. Add the third part of 90 to the fifth part of 100.

52. I had 5s. 6d. in a bag. I gave 6d. to each of 3 boys. How much left?

53. How many sixpences in the sum of 4s. 6d., 3s., and 6d.?

54. I buy a book for threepence. How many can I buy with 4s.? 5s.? 6s.? 8s.?

55. Add 4 times 8 to 5 times 10.

56. What must you add to the sum of 48, 20, and 12, to make 96?

57. What must you add to 5s. 1d. to make 7s.? to make 8s.?

58. One boy has 3 sixpences in a box, and another has 90 pence. How much altogether?

59. Find the cost of 5 dozen pears at 4 for 6d.

60. A man earns 2s. a day and his son 6d. How much will they together earn in a week of 6 days?

ELEMENTARY LESSONS IN AGRICULTURAL ZOOLOGY.

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CHAPTER VIII.—Insects (*continued*).—Leaf-Beetles.

The next group of beetles which calls for our consideration bring forcibly to our mind one of the greatest scares that ever came over agriculturists. It is now some twenty or more years ago that the outcry was raised that the Colorado Beetle was upon us. The Americans called it the 'Potato Bug,' and told us weird tales of its destructiveness, pointing to acres upon acres devastated by its voracity. Wonderful were the efforts made to secure its destruction before it should invade us, extraordinary the vigilance and care to prevent the surreptitious landing of a single representative of the dreaded tribe. All this is ancient history now; no longer is the danger formidable. So great was the care taken, however, that the Colorado Beetle never succeeded in coming over to us except preserved in spirits of wine, to take its place in agricultural museums.

The family to which the Colorado Beetle or Potato Bug belongs is known as the Chrysomelidæ, or leaf-beetles. They are small, generally thick-set beetles, arched on the upper side, with eleven-jointed antennæ, thickening somewhat towards their tips, and with feet having four joints. The foremost of these pedal joints are covered with felt-like hairs on their under surfaces. The larvæ have three pairs of thoracic feet, and in addition to these they are furnished, in most species, with a pair of caudal prolegs. Some of them live in the inside of the stems and leaves of plants, and are usually elongated and yellowish-white in colour; others are found altogether on the outside of the plants; they are more convex in shape than the former; are short and thick, sometimes covered with hairs, and always show dark spots or lines, or other markings upon some striking ground colour, often yellow.

They are known as leaf-beetles because the leaf is the part of the plant especially attacked by them. The adult beetle eats leaves, and, as we have seen, the larva in particular affects this form of food, sometimes attacking the leaf from the outside, sometimes excavating channels in its interior or in that of the stem. Most leaf-beetles lay many eggs, and in many species there are several generations annually.

The name by which the Colorado Beetle is known to science is *Chrysomela decemlineata*. He is about half an inch long, a dusky yellow insect, with his wing cases or elytra marked with ten longitudinal broad black bars, five on each. These bars run the whole length of his back, and are continuous with black markings on his neck shield. Hence the specific name *decemlineata*, or ten-lined. The larva is about as long as the adult beetle, and is thick and fleshy, its legs, however, being short and weak. In colour the larva is orange-yellow, with a shining black head and with black spots on the body segments. When the larva is very young the orange-yellow colour is very dark, almost inclining to the colour of blood; it becomes lighter as the insect gets older.

This beetle was originally confined to the west of the United States, where it lived on wild plants belonging to the Potato family. As soon as the potato plant began to be cultivated in these far western States, the beetle abandoned its original supporters for the new succulent crop. The luxuriance of the new food fitted in well with the wonderful powers of reproduction that the insect possesses, and quickly the pest spread. The beetles soon were noticeably advancing towards the east, especially invading the places where potato cultivation was a leading feature of the agriculture. Beginning to be known in 1859 in the State of Colorado, they were found on the east of the Mississippi in 1865, and in 1870 they had spread over the States of Indiana, Ohio, Pennsylvania, Massachusetts, and New York. The scare which followed in England, and indeed in most European countries, has already been alluded to.

The ravages of the pest may be shortly described. When the young potato plants come up in an infested field, the beetles that have survived the winter creep out of the soil and devour the margins of the young leaves. The female lays something like a thousand yellow eggs in heaps upon the leaves, and after only about a week the larvæ emerge from them, well endowed with voracious appetites and eager to continue the depredations of their parents. They attain their full development in rather less than three weeks, and, falling from the plant to the soil, bury themselves a little below the surface and assume the pupa stage. This again is not very prolonged, and the new crop of adult insects makes its appearance about the middle of June. This gives plenty of time for a third brood to appear before the end of the year, so that the ultimate progeny of a single pair is large enough to warrant the fears that the name of the

insect has always raised out in the States. A curious feature about the reproduction is that as a considerable time elapses between the laying of the first and second batches of eggs, one usually sees eggs, larvæ, pupæ, and beetles at the same time.

The devastation when the plague once sets in in a district is dreadful; entire potato fields are eaten bare by the beetles and their larvæ, the formation of the tubers being quite prevented.

Another beetle of this family attacks another very favourite item of our vegetable diet, the asparagus. The so-called Asparagus Beetle, *Crioceris asparagi*, is smaller than the Colorado Beetle, but is still larger and more conspicuous than many of the leaf-beetles, and is one of the most handsome members of a particularly handsome family.

This little beetle is about one-fifth of an inch in length, and may be at once recognised by three large yellow-white patches, arranged one above another, upon each of the dark green wing cases. The head is bluish-green, and the thorax a dull red, and the wing cases are edged with a stripe of the same colour. The antennæ and the legs are also bluish-green.

The eggs of this insect are laid by the female in rows along the asparagus shoots, and from them emerge short, stout-limbed grubs of a dull slate-coloured hue. They have the power, when disturbed or handled, of ejecting from their mouths a drop of black, offensive-smelling fluid. Like the last-named insect, their development proceeds with great rapidity, their growth being completed in little more than a fortnight, when they too fall to the ground, and, burrowing below the surface, provide themselves with small parchment-like cocoons, in which to spend their pupa state. The pupa only remains in the cocoon for about a fortnight, when the adult insect appears. The latter is singularly expeditious in preparing to continue its species, egg-laying beginning almost as soon as the beetle has made its own appearance. Not only three, therefore, but several broods make their appearance in a single season, and the insect may be found, in one stage or another, from early in summer until late in autumn.

The damage done by this beetle is not confined to the leaves, the delicate shoots also being attacked.

The third member of this family of *Chrysomelidæ* that calls for our notice is one which preys upon our cruciferous plants, troubling, perhaps, the market gardener more even than the farmer. Mustard, cress, cabbages, horse-radish, radishes, and other cultivated cruciferæ are the objects of its ravages. This is *Phædon betulæ*, commonly known as the blue beetle, a small insect whose length does not exceed an eighth of an inch. The whole of the upper surface of this beetle is of a uniform blue colour, tending towards bluish green; the thorax is evenly punctated throughout, and the wing cases are ornamented with several rows of large and small dots.

It is very destructive during both the larval and the adult periods of its existence, and has been known to attack and destroy entire fields of mustard, cress, cabbages, etc. Its attacks are noticeable about the time of the formation of the fruit, from the stalks of which it strips all the outer portions. Attacking other cruciferous plants the insects eat first the leaf and then the large stem swellings, which farmers frequently call the *bulb*.

The perfect insect apparently survives the winter in a state of hibernation, reappearing in the spring on cruciferous plants, on which it lays its eggs. The latter are elongated, oval, dark yellow structures, and are deposited on the under side of the leaf.

The larva when hatched feeds first on the leaves, and, when these are exhausted, it attacks the cuticle of the stem, just as the adult insect does. The perfect beetle appears in August.

Its hibernating in the winter is usually carried out under the loose bark of trees.

Phyllotreta undulata is a still more terrible pest than the foregoing. It is commonly called the *Turnip Flea*, the vegetable chiefly affected by it giving it the one name and its terrific powers of jumping the other. It is needless to say it has nothing beyond this power in common with the group of the fleas, being only an ordinary leaf-beetle. It is furnished with a wonderful pair of hind legs, whose muscular development, particularly that of the thighs, is extraordinary. The turnip flea is little more than a twelfth of an inch long, but it can spring at a bound over at least a space of eighteen inches, or more than two hundred times its own length.

The insect is egg-shaped, black in colour, with longitudinal streaks of a pale yellow colour on the thickly-pitted wing covers. The larva is one fifth of an inch long, yellowish white in appearance, with dark brown head and tail.

The danger which the insect introduces is altogether due to the enormous numbers in which it appears. Individually the beetle is not capable of doing much damage. In seasons of serious attack it is said that the depredators can be removed from the plants almost in pailfuls.

Its life history is rather curious, differing in certain points from that of any beetle we have yet discussed. Very few eggs are laid, and never more than two or three appear to be deposited in the course of a single day. These eggs are fastened to the turnip leaves, which they very closely resemble in colour, and they hatch in about ten or twelve days. The grubs burrow at once into the leaves and feed upon the mesophyll, leaving the two epidermises untouched. They are thus protected and shielded by the membrane of the leaf while carrying out their depredations upon the delicate interior.

This process of excavation is carried on for about a fortnight, and then, like most of the family, they seek an underground abode in which to pass their pupahood. A fortnight again seems to be long enough for this stage in their life, and at its end the perfect beetle appears. Several successive broods appear during the summer, and at its close a number of them hibernate, taking shelter for the winter in stubble, or tufts of grass, or behind loose patches of bark.

The damage they do to the turnips depends not only on the number of the beetles, but upon the stage at which the plant is when the attack is made. The first appearance of the turnip from the seed is marked by the emergence of its two cotyledons or seed leaves from the soil and their becoming green. This is the most vulnerable stage in its history, and if the beetles should appear in any numbers then, there is but little hope of a crop.

They do not care so much for the rough leaves which the plant bears later in its life, but will feed upon them in default of the younger ones.

The attacks of the perfect insect can be distinguished from those of the larva, for the former perforates the leaf blades, causing them to appear riddled with small holes.

Two other members of this family infest the rape and the cabbage respectively. They are much like the turnip flea in their general characteristics. The adult cabbage flea attacks the young plants in the spring, particularly seedlings; the larva, on the other hand, which appears later, preys upon the mature plants.

(*To be continued.*)

OUR 1896 CERTIFICATE CLASS.

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QUESTIONS FOR REVISION.

FIRST YEAR—MEN.

N.B.—Students are strongly urged to set aside Saturday for WRITING OUT answers to these questions.

In addition to getting up the work indicated in the syllabuses previously printed, students are recommended in the week to prepare answers for writing out on Saturday. This method promotes precision and definiteness.

Reading, etc.

Students should mark out a certain portion of the book they choose for reading, and the lines for repetition, and carefully look over for significant emphasis, phrasing, accent, etc., and then get their head teachers, or some well educated person, to hear them recite and read each week.

The full mark for reading is difficult to get, and cannot be got without much practice under criticism.

Penmanship, etc.

1. Write the passage below, dictated as marked. Full stops only to be given.

When all the motions | of the heavenly bodies | have been reduced | to the dominion of gravitation, | gravitation itself | still remains | an insoluble problem. Why it is | that matter attracts matter, | we do not know, | we perhaps never shall know. Science | can throw much light | upon the laws | that preside | over the development of life; | but what life is, | and what is its ultimate cause, | we are utterly unable to say. The mind of man | which can track | the course of the comet | and measure | the velocity of light, | has hitherto proved incapable of explaining | the existence of the minutest insect, | or the growth | of the most humble plant. | In grouping phenomena, | in ascertaining their sequences | and their analogies, | its achievements | have been marvellous; | in discovering ultimate causes | it has absolutely failed. | An impenetrable mystery | lies at the root | of every existing thing.

| The first principle, the dynamic force, | the vivifying power, the efficient causes | of those successions | which we term natural laws, | elude the utmost efforts | of our researches.

LECKY.

2. Write in text hand and small hand :—

'Banquo is down, Fleance fled.'

Composition.

Write an essay on :—

(*a*) 'The great angel of the sea—rain.'
(*b*) A flower.
(*c*) A summer holiday.
(*d*) Professionalism in football.

School Management.

1. What is meant by the 'association of ideas'? Give examples of different kinds of mental association, and show what practical bearing this question has on a teacher's work.

2. Describe the cause and cure of the habit of vague and inaccurate observation.

3. What is the exact meaning of each of these words:—Reminiscence, Recollection, Memory? Give some simple, practical rules with reference to the character and right use of memory exercises in schools.

4. Describe fully the process which goes on when we *perceive* an object; and explain, as to a class of Sixth Standard children, the nature and structure of the organ of sight.

5. Name those subjects in a school course which are valuable respectively (1) as useful information; (2) as practically serviceable in the business of life; (3) as instruments of mental development; and (4) as helpful in the formation of tastes and character. Give reasons for your answer.

6. Give examples of the inductive method of treating a lesson, and illustrate your answer by notes on one of these subjects—

(*a*) A transitive verb;
(*b*) The measurement of surfaces;
(*c*) (For Infants.) Colours.

7. In teaching history, what use do you propose to make of dates? Explain how you would teach chronology; how much of it ought to be taught; and what mistakes are often made in teaching it.

Music.

1. What other four contiguous tones of the scale are separated by the same steps or intervals as—

(a) *me, fah, soh, lah.*
(b) *ray, me, fah, soh?*

2. Which are the leaning or expectant tones of the scale, and which are the strong tones or tones of repose?

3. What circumstances tend to modify the mental effects of scale tones?

4. Name (as major third, etc.) the following intervals:

(1) r t	(2) t_1 s	(3) r l	(4) f t
(5) m d^1	(6) t_1 f	(7) r f	(8) fe l

5. Re-arrange the following notes in order of pitch, placing the lowest note first in each case:

(*a*) s d_1 m r^1 t_1 fe d s_1 ta l_1 r
(*b*) ta_1 m r^1 f t_1 fe l d m^1 s l_1

6. Which of the following notes is highest in pitch, and which lowest?

(1) t, in Key C. (2) l, in Key B♭. (3) m, in Key A♭. (4) r, in Key D. (5) f in Key B.

English.

Gray. 1. Ode I. Parse—disclose (3), reclined (17), vain (18), youth are (25). Analyse lines 41–50.

2. Ode II. Parse—that blow (3), reclined (5), still, she (13), cat's (24), to send (33). Analyse 37–42.

3. Ode III. Parse—hills (11), stranger yet (14), disporting (23), vultures (62), destroy (98). Analyse 81–90.

4. Comment on: rosybosomed hours, Venus, Attic warbler, genii, Tyrian hue, rolling circle, flying ball.

5. Give an account of the genesis of the second Ode.

6. Write a short account of the subject matter of the Tractate.

Geography.

1. Describe the course of the Trent (naming the chief towns, tributaries, counties).

2. Describe the physical features of the west coast of Scotland and the east coast of Ireland.

3. Give some account of the climate of Australia, and of the principal animals to be found there. Remark on any differences you have observed in the description of the native animals of Australia and the animals of the Asiatic continent.

4. What are the principal industries of the people—(1) Jamaica, (2) Cape Colony, (3) Tasmania.

5. Give a list of all our colonies and dependencies in the western hemisphere in order of their population and importance.

6. Describe with the aid of a map the great lakes of British North America.

History.

1. Name the three longest and three shortest reigns, with dates.

2. Assign events to 901, 1066, 1215, 1346, 1485, 1588, 1605, 1649, 1760, 1789.

3. What English sovereigns have been distinguished as legislators, soldiers, scholars?

4. Name the chief legislative Acts of Henry VII.

5. Say what you know of Simnel, Sir T. More, Cecil, Darnley, Wolsey.

6. What do you understand by Benevolences, Monopolies, Six Articles, the Suppression of Monasteries?

Arithmetic.

1. Prove that the order of multiplication of two numbers is immaterial. Multiply 4327 by 814 and explain the process. Multiply 32856 by 121711, using three lines of multiplication only.

2. Multiply 43,002,073,252 by 133,112,111 in three lines.

3. Define a prime number. Express 364, 2520, and 5445 as products of powers of prime numbers.

4. A, B, and C, starting together, skate round a pond one mile in circumference at the rate of 6, 10, and 12 miles an hour respectively. How often will A be passed by B, how often by C, in an hour's time? and how often, and at what intervals of time, will the three be exactly abreast.

5. Five horses start together, and continue running round a circular course which is two miles in circumference. If they run respectively 18, 16, 15, 12, and 10 miles per hour, how soon will they be again together at the starting-point?

6. Find the least number of ounces of standard gold that can be coined into an exact number of half-sovereigns, standard gold being coined at the rate of £3 17s. 10½d. to an ounce.

Algebra.

1. Express algebraically—

(*a*) The fourth power of the difference of two numbers together with twice the product of their squares, is equal to the difference between the sum of their fourth powers and four times the product of their product and the square of their difference.

(*b*) Find the value of—

$$(a-c)^2-(3b-c^2)+\sqrt{(a-c)(b-d)}$$

when $a=16$, $b=10$, $c=5$, $d=-1$.

2. Prove that—

$$a(a+1)(a+2)(a+3)+1=(a^2+3a+1)^2,$$

and divide

$$x^3-2mx^2+(m^2+mn-n^2)x-m^2n+mn^2 \text{ by } x-m+n.$$

3. If c be a common measure of a and b, it will also measure $ma \pm nb$.

Find G.C.M. of—

$$16x^4-53x^2+45x+6 \text{ and } 8x^4-30x^3+31x^2-12.$$

4. If $\frac{a}{b}=\frac{c}{d}=\frac{e}{f}$ prove that *each* of these fractions is equal to

$$\frac{ma+nc+pe}{mb+nd+pf}.$$

5. Find square root of—

$$(x^2-a^2)^2+(2ax-x^2)(2ax-a^2),$$

and prove that

$$\frac{\sqrt{5+2\sqrt{6}}+\sqrt{5-2\sqrt{6}}}{\sqrt{5+2\sqrt{6}}-\sqrt{5-2\sqrt{6}}}=\frac{\sqrt{6}}{2}.$$

6. Solve the equations—

(*a*) $\frac{7x-9}{20}-\frac{9x-7}{14}=\frac{5x-3}{16}-4$.

(*b*) $17x^2+19x-1848=0$.

7. Insert a given number of arithmetic means between two given quantities. Find the series in A.P. in which the 5th term is 1 and the 30th term is -74.

8. A man looks at his watch, and, mistaking the hands, thinks the time to be 55 minutes earlier than it is. Find the real time which is between 3 and 4.

Euclid.

1. Prove I. 1. If the apexes of the two possible triangles be joined, prove that the square of the line is three times the square of the given line.

2. Prove I. 4. If two lines be at right angles, and if each bisect the other, then any point in either is equally distant from the extremities of the other.

3. Prove I. 5. Each diagonal of a lozenge is an axis of symmetry of the lozenge.

4. Prove II. 1. From the hypotenuse of a right-angled triangle portions are cut off equal to the adjacent sides; prove that the square on the middle segment is equal to twice the rectangle contained by the extreme segments.

5. Prove III. 3. Every circle passing through a given point and having its centre on a given line, passes through another given point.

6. Prove III. 5. If two circles have three points in common, they coincide.

FIRST YEAR—WOMEN.

Reading, etc.
Penmanship.
School Management.
English Composition.
Music.
English.
Geography.
History.
} Same as Men.

Needlework.

1. Cut out in paper and make up one leg of a pair of drawers for a child of from three to five years of age.

2. Cut out and tack together half the front and half the back of a woman's chemise.

3. On the piece of calico enclosed (6 × 6) show not less than three inches of the following stitches:—Hemming, sewing, stitching, and feather stitching.

Arithmetic.

1. Divide 30,000 by 9,375 by long division and by factors.

2. An Indian officer, whose annual pay was estimated in rupees, lost £145 5s. 10d. in one year by a fall in the value of the rupee from 1s. 10½d. to 1s. 7¾d.; what was his salary, estimated in rupees?

3. Find the G.C.M. of 4,081, 7,007, and 7,392 by expressing them in their prime factors.

4. Find the least number of pounds which can be paid in either half-crowns or guineas.

5. A man who has lost ½ of $\frac{\frac{1}{8}}{\frac{1}{2}-\frac{1}{10}}$ of his capital has £3,500 remaining; what sum did he lose?

6. A's share is ·06 of B's, B's is 3·08 of C's, C's is 1·1 of D's; C's share is £2,750; find A's, B's, and D's.

Domestic Economy.

1. Why is it needful that bedrooms should be ventilated, and how may this object best be effected?

2. Give a few simple counsels suited to a pupil teacher on these subjects:—Diet, sleep, economy of strength, and add reasons in each case for the advice you give.

3. What are arrowroot and Indian corn? What are the special qualities which fit them to be used as food, and how may they best be prepared for use?

4. Explain the use of eggs in cooking. How may they be best preserved for later use?

5. Explain fully how to lay and light (1) a close stove, (2) an open fire.

6. Describe fully any washing machines known to you. Explain their advantages, and show what precautions or rules should be observed in using them.

SECOND YEAR.—MEN.

Reading.

Ruskin's 'Frondes Agrestes' is the more interesting of the two books, and can be obtained in a cheap edition (Geo. Allen). The general advice is the same as for First Year.

Penmanship.
Composition.
Gray.
Geography.
History.
} As First Year.

Teaching.

Many acting teachers do not get as many marks for their practical work as they might reasonably expect, and that largely from lack of finish and definiteness in their notes and exposition. The best practice is, without doubt, obtained by securing the co-operation of the head teacher, and giving a series of set lessons, notes having been previously written, so that the criticism may be definite and specific.

School Management.

1. (*a.*) In the Class Registers, how will you ensure the *correctness* of (i) the number entered at every meeting at the foot of the attendance column? (ii) of the 'total attendances' of the week, and of the quarter? How would you deal with the registration of scholars who come too late to be marked in the registers? How would you mark holidays and days devoted to Examinations in Religious Knowledge?

(*b.*) (i) If the school attendance is irregular, describe in what form you could, from the registers, draw up a statement to put this irregularity in a striking light? (ii) How do you find the 'average number of times attended per week by each child present at all?' and of what use is this number? (iii) How would you record *punctual* attendance? (iv) Why would you write up the daily attendance in view of the school?

2. What is understood by a proposition, a premiss, a conclusion, and a syllogism? Give an example of each.

3. Assuming the truth of the statement that

(i) If *A* is *B*, *C* is *D*,

say what inference, if any, can be drawn from each of the following further statements:—

(ii) But *A* is *B*.
(iii) But *A* is not *B*.
(iv) But *C* is *D*.
(v) But *C* is not *D*.

If in any of the cases no inference can be drawn, give the reason. Illustrate your answer by examples.

4. 'A generic term *denotes* a larger number of objects than a specific term; but it *connotes* a smaller number of attributes.' Explain this statement, and illustrate it by examples.

5. When and how far is it desirable to refer to the Latin or Greek derivation of a word in teaching children? Say what kind of previous knowledge should be possessed by them before such reference is made; and give examples of some words the meaning of which is made clearer by their etymology, and of others in which that meaning is obscured by it.

6. Write an abstract of Quick's account of Locke.

Music.

1. Write each of the following intervals in the scale in which it would occur according to the better method.

(*a*) **f t**, (*b*) **m . ta**, (*c*) **s . de'**, (*d*) **se . r'**.

2. What do you understand by a pulse? What by a measure?

3. Transcribe the following passage into two-pulse measure (*i.e.*, write in one pulse what is here in three pulses):

s :— :f | m :f :s	**l :t :d' | s :— :—**
l :— :— | r :m :f	**m :— :— | — :— :—**

4. State the average compass of Trebles (adults), Altos (adults), Tenors, and Basses.

5. Describe the beating of time of (1) two beats in a measure, (2) three beats in a measure, (3) four beats in a measure.

6. State the meanings of the following terms :—

(1) A tempo. (4) Dal Segno.
(2) Ad libitum. (5) Grazioso.
(3) Adagio. (6) Calando.

English.

Richard II.

1. Write the eighteen lines commencing: 'All places that the eye of heaven visits.'

2. Show that 'unity of subject' has been carefully observed in the play.

3. Explain the allusions in :—

'Mine innocency and St. George to thine.'
'Julius Cæsar's ill-erected tower.'
'Like glistening Phæton.'

4. Give the derivation of lewd, rancour, career, and parse *which*, line 90, and scan line 23, Sc. I.

Macbeth.

1. Under what circumstances and by whom are the following words used—

'When shall we three meet again.'

2. Compare the opening scene with that of Hamlet and Julius Cæsar.

3. What is blank verse? Give examples from the play. What are the usual exceptions?

Tempest.

1. What peculiar circumstances may have suggested the play?

2. Write a summary of Scene II. Act i. of the play.

3. Criticise the seamanship displayed in Sc. I. Act i.

Algebra.

N.B.—Get up well the bookwork indicated in the questions.

Questions 1–8 as First Year.

9. Define a logarithm. What operations are shortened by the aid of logarithms?

If the logs of 3 quantities are in A.P., prove that the quantities are in continued proportion.

Given log 2 and log 3 ; find log 108 and log ·00142.

10. The population of a town increases annually by 4 per cent.; what proportionate addition to the population will be made in a period of ten years?

$\log 1{\cdot}04 = {\cdot}017033$; $\log 1{\cdot}48 = {\cdot}170330$.

11. If the number of permutations which can be formed with n things taken 3 together is $56n$, find n.

12. Assuming that the coefficient of x^{r-1} in the expansion of $(1+a_1x)(1+a_2x) \ldots\ldots (1+a^{r-1}x)$ is the number of combinations of a_1, a_2, etc. $(r-1)$ together ; find the coefficient of x^r in the expansion of $(1+a_1x)\ (1+a_2x) \ldots\ldots (1+a^rx)$.

Find the first three and the $(r+1)$th term of the expansion of $(1-x)^n$.

13. Solve the equations :—

(*a*) $(4x-a)^2 = 9(x-b)(a-b)$.

(*b*) $x^2+y^2 = 74$.
$x^3+x^2y+xy^2+y^3 = 888$.

(*c*) The equations $x^3-9x^2-16x+144 = 0$,
$x^3+7x^2-20x-96 = 0$,
have one root in common, find this root.

14. A man who saved every year half as much again as he had saved in the previous year, had at the end of eight years £26 5s. 5d. How much did he save in the first year?

Euclid.

1–6. As First Year.

7. Prove IV. 2. The square of the side of an equilateral triangle inscribed in a circle equals three times the square of the radius.

8. Prove VI. 1. If two lines be cut by three or more parallels, the intercepts on one are proportional to the corresponding intercepts on the other.

SECOND YEAR—WOMEN.

Reading.
Penmanship.
School Management.
Composition.
Music.
English.
Geography.
History.
} As Men.

Needlework.

1. Cut and make up the upper part of a boy's shirt and one sleeve ($\frac{1}{2}$ size).

2. Make and set-in a gusset as for the side opening of a shirt.

Arithmetic.

1. There are 100 links in a chain, which is 22 yards long ; how many square links will there be in a field which contains $3\frac{1}{2}$ acres?

2. No. 3, men.

3. Find the L.C.M. of $10\frac{1}{2}$, $6\frac{7}{8}$, $4\frac{8}{10}$.

4. No. 4, men.

5. No. 5, men.

6. No. 6, men.

7. Simplify—

$9(3a-b)(3a+b)-7(2a+b)^2+3(2a-3b)(a+4b)$,
and divide, $x^3-13x-30$ by x^2-2x+3.

Solve the equation—

$$\frac{x+6}{4}-\frac{16-3x}{12}-4\tfrac{1}{8} = 0.$$

Domestic Economy.

1. Mention the principal ways of preparing eggs, and (1) describe the process of making an omelette.

2. Point out some forms of thriftlessness or extravagance common among the poorer classes.

3. Explain what is meant by 'National Insurance,' with reasons for or against the scheme.

4. Mention any dangers incident to the use of (1) gas, (2) paraffin lamps ; and show how these dangers may be avoided.

5. Give a scheme of a week's cheap dinners for a working-man's table, with family of five persons.

6. How may (1) rice, (2) barley, (3) maize be used advantageously as food for invalids or children?

NOTES AND NOTIONS.

BY RICHARD WADDINGTON.

The debate on the Education Estimates gave Messrs. Gray and Yoxall an opportunity for their maiden efforts as Parliamentary debaters. The wisdom of direct representation was fully confirmed. In matter, style, and method of delivery, both speeches drew pleasing testimony from Mr. Acland and Sir John Gorst. Personally there can be no doubt the teacher M.P.s scored, and scored heavily. But the direct benefits that must fall to the profession are by no means slight. At last there is a possibility of Article 73 being amended by the withdrawal of the absurd distinction between teachers who have been through a Training College and those who have not. The Rural School problem is to receive attention. Superannuation is to be dealt with next Session. The Voluntary Schools are to be assisted, and the age at which children leave school for work is a matter on which Sir John hopes to legislate. Not by any means a bad beginning for the Vice-president, I think.

What about Suitable Occupations? Will Sir John so far undo the mischief wrought by Mr. Acland as to make these optional instead of compulsory or obligatory subjects? None too soon the Executive of the N.U.T. intends to approach Sir John on this burning question. There will be no difficulty, I think, in proving that the number of obligatory subjects is altogether out of proportion to the possibilities of the children. As for this 'paper snipping' and 'paper pasting,' I don't believe in its necessity. Where the school life runs to sixteen or seventeen it may be well to train the hand and the eye in the early years, but when it is remembered that our Primary School children leave school at eleven years of age in more than half the schools of the country, there can be no doubt that the Suitable Occupations may be omitted. Before me lies a sheet issued by the South-East Lancashire District Union that must demonstrate to any intelligent person the impossibility of covering the ground required even in fairly well situated schools, to say nothing of the ten thousand small schools.

* * * * *

The Trades Union Congress has given Sir John Gorst 'the line' on the question of Child Labour. At the final meeting of the Cardiff Congress the following resolution was moved:—

'Employment of Children.—Mr. T. R. Clynes (Gasworkers' and General Labourers' Union, Oldham) moved—"Considering that the employment of children in factories and workshops and their consequent exploitation by the capitalist is injurious to the children, unjust to their parents, and a crime against the human race; considering the infamous fact that the children of the working class have not the same opportunities for the class-room and the playground as the children of the capitalist class; considering that in this connection Great Britain is behind other countries; considering that unhappy parents under an unhappy system are actually willing, and even anxious, to have their children torn from school and hurled into the factory, this Congress is of opinion that the time has come for Great Britain to cease building its empire upon children's hearts—to give up coining its wealth out of children's wasted lives; and demands, as a temporary minimum from the Government, the abolition of child labour until the age of fifteen, and of all night labour until the age of eighteen." He said that, as the time of the Congress was now so limited, he would content himself with moving the resolution, but it should be remembered that foreign nations kept their children at school much longer than did we. Mr. Bland (Bradford) seconded the resolution. When the resolution was about to be put there were loud cries of "No." Mr. T. Glover (Lancashire) said that if the age limit were altered from fifteen to fourteen years there would be no opposition. Mr. Clynes accepted the alteration, and with this amendment the resolution was adopted.'

With this resolution from the organised workers, and the Berlin pledge, Sir John ought not to hesitate about raising the age to thirteen at once, and thus bring happiness to the one hundred and seventy thousand little workers.

* * * * *

But the Cotton Weavers of Accrington endeavoured to upset this resolution at a later stage. They wanted legislation to allow twelve-year old Trades Unionists, as will be seen from the following report:—

'Youths and Trade Unions.—Mr. Wilkinson (Cotton Weavers, Accrington), moved—"That it be an instruction to the Parliamentary Committee of the Trades Union Congress to make an attempt to get the Trades Acts of 1871 and 1876 so amended that a person of the age of twelve years may become a member of a registered trade union." He said that at present they were hindered by the law from taking many young people into their unions. The young people would join as soon as they began work, but the legal enactment was against them.—Mr. J. Cross seconded the resolution. Mr. Bailey (Notts Miners), for the Miners' National Federation, moved an amendment that the age of "twelve years" be deleted from the resolution, and "fourteen years" inserted in its place. He said it would be absurd for the Congress—as it had just done—to carry a resolution that children ought to stay at school until they were fourteen years old, and then carry another that they should join a trade union at twelve years of age. (Applause.) This was a question on which trade unionists ought to take firm and sensible ground. Harm all round was occasioned by children being put to work too early. (Applause). Mr. T. Glover (Lancashire Miners) seconded the amendment. He asked Mr. Wilkinson to accept the amendment, so that the united voice of the Congress might go forth on the matter. Surely they were not going to pass a resolution which virtually said that twelve years was the proper age at which to become a workman? (Applause.) The amendment was not accepted by the mover of the resolution, and a vote of the Congress was taken by show of card. The amendment was then carried by a large majority, the voting being: For the amendment, 679,000; against, 91,000; majority for, 588,000. The figures in the resolution were altered to "fourteen" and the resolution was then adopted.'

* * * * *

It is astounding how tenaciously some of the workers of the North stick to this early child labour. Oldham employs some six thousand half-timers. The upper standards of the schools of Oldham are almost entirely composed of half-timers. True, during the late agitation the Oldham Trades Council and the School Board were for raising the age to 12 years. But this roused the ire of some of the operatives, and there was secession from the Trades Council. You see, the cotton operatives are so poor. The month of September is 'Wakes month' in Oldham. The mills stop for a week. For months before the operatives contribute to clubs. These clubs are banks on a small scale. And these poor operatives, who are compelled to send their eleven-year-old children to work, divided £110,000 last week for going away. This is about a pound a head for every man, woman, and child in Oldham, whether working in the factory or not. Is there another town of the size of Oldham whose workers spend £110,000 on a week's holiday? Don't mistake me. I'm not sorry they have this money—I wish it was more, not less. But they mustn't cry poverty as the reason for sending their children to work.

* * * * *

The scheme of salaries issued in connection with the Archbishop's Scheme for Voluntary Schools deserves the close attention of all teachers. It is the most unsatisfactory effort to solve the problem that has yet appeared. Head teachers of large schools will invariably gain under the scheme, while the assistants will receive very inadequate treatment indeed. The compilers seem to have forgotten that a very large percentage of our assistants are doomed to perpetual assistantships, and that, therefore, the scheme ought to provide a living wage for all teachers. In my own case I should gain £70 a year under the scheme, while my colleagues, who are not by any means well paid, would lose £50 a year. This is absolutely unsatisfactory; and on such lines the scheme must meet with the active opposition of all classes of teachers. Despite the temptation to accept the scheme presented to many head teachers, I have no doubt we shall close our ranks as a Union and fight for a fair scheme all round. There is a good old Lancashire word which, I believe, will express the action of all teachers, and that is 'Jannock.'

THE small School Board has done much to bring education into ridicule through the eccentricities of the members, who are generally chosen for reasons other than educational; but a letter which came under my notice the other day passeth understanding. The letter began, 'Their his a hynne inn the villiage.' After this I have no further doubt of the authenticity of the story told of the School Board member who announced, when H.M. Inspector reported that the teaching ought to be more concrete, that he could supply a load or two of concrete.

* * * * *

THE usual variations are evident in the Science and Art results this year. In some subjects the failures are too numerous to be enumerated, while in others the successes are marked. Schools taking a number of subjects arrive at the same result as last year, as a rule; but where the number of subjects taken are few the loss of grant has been serious. It is a pity that this annual fluctuation takes place, as it does so much to destroy real teaching by disheartening both teacher and taught. Some day South Kensington will awake to the necessity of offering encouragement to Science and Art teaching in reality.

* * * * *

A GOOD deal of sarcasm is being vented on the pedagogues whose schools, being placed under the new order of inspection, are announced in the local press as therefore of special quality. That these announcements should appear is deplorable, and too often the evidence of the want of an improved professional spirit. But it must not be forgotten that the teacher is not always to blame. I have in my mind at the present moment more than one case where the announcement has been made without the teacher's direct or indirect approval. Let us by all means 'go for' the teacher where the teacher is to blame, but let us, also, keep well in mind the fact that the teacher is not always the author or inspirer of these items of news.

* * * * *

THE abolition of the fixed examination makes it all the more necessary that some means should be found of providing certificates of exemption. At present there is a great demand for the last five years' attendance as the qualification for work. As I have explained over and over again, this throws a large amount of unnecessary labour on the teachers. The standard pass is breaking down owing to the prevalence of sample examination. When intermittent inspection becomes general, the problem will be still more difficult. Now is the time for pressing the Age and Attendance Scheme of the N.U.T. If Sir John Gorst intends to unify and simplify the law as it affects child labour, we ought to get our scheme to the front as soon as possible.

* * * * *

THE report of the Secondary Education Commission is expected daily. But there is really no hurry, I fear. The legislative effort of the Government for next session is already fairly large. So far Sir John Gorst has promised—

1. Superannuation.
2. Increased aid for Voluntary Schools.
3. Unification of the law on Child Labour.

WHEN it is borne in mind that the first and second will require to figure in the estimates, it must be admitted that the probability of the Government venturing into a Secondary Education Bill is rather remote. Like all other commissions, the Secondary Education Commission is likely to be amply digested and fully quoted before its recommendations reach the dignity of a Bill, to say nothing of an Act of Parliament.

* * * * *

THE correspondence in the *Times* on the advantages of elementary school teaching for ladies of gentle birth is highly amusing. The idea of painting the conditions of existence of the rural teachers in such rosy hues does credit to the imagination, if not to the veracity, of the advocates. Last week Mr. Macnamara let some light on the problem by giving some facts and figures from his Oxford paper on the 'Rural Schoolmistress.' How some of the correspondents dare write such fiction passes comprehension. Paint the rural schools as daintily as you will, the 'ladies of gentle birth' will hardly venture to seek employment therein; or, if they do, the tenure will be a short one. It does not need more than a passing acquaintance with the schools of rural England to know that the gentler the birth the shorter the stay under the conditions imposed. What some of the clergy appear to desire is an influx of aristocratic-work-for-nothing-teachers who will do all and take nothing. But you see the surroundings are against the project. You may get this in a big bazaar for a day or two, but the rural schools offer steady drudgery without limelights.

* * * * *

THE Brighton teachers intend to make 'Breezy Brighton' memorable. Thirty thousand members for Brighton is assured. Is it to be twenty thousand for the funds? Brighton will do its share, but without the help of the other associations the accomplishment is impossible. It is the old story. If everybody will do a little the thing is certain. With the good work done by the Orphanage and Benevolent Funds it is a shame that there should be a single teacher whose name is not down as a contributor. When the time of trouble comes it is just the non-contributors who are most eager to utilize the funds. One does not want to visit the sins of the fathers on the children, but it does seem curious that so many of those who turn a deaf ear to appeals for years are too often the ones to require the assistance of the funds for themselves or their families. Manchester broke the record. 'Breezy Brighton' wants to eclipse Manchester. It is rivalry in a good cause. Will every teacher take the hint and help Brighton? The Brighton teachers will need all the help that can be given to surpass the total reached at Manchester.

* * * * *

THE teachers who are just commencing their school year are finding out the impossibility of arranging the time table so as to include Suitable Occupations and Object Lessons. If the Executive of the N.U.T. does not succeed in removing these from the list of obligatory subjects, the lot of the average teacher will be a hard one. But the pressure will not only rest on the teachers, but on the taught. How all this work is to be got through it is impossible to conceive.

There will be overtime, and consequent over-pressure. All this will do serious harm to education, and fully demonstrates how easily a faddist may make the machinery get out of gear. Teachers ought to be up and doing just now. A year ago we had protests loud and deep. Everywhere the cry was heard. The relief granted is extremely small, and in many cases only serves to aggravate the position. The permission to take Object Lessons as a Class Subject is a doubtful reduction when it is remembered that the Fourth Standard will have to take four years' work in Grammar or Geography in one year. We ought to be up and doing on this subject.

TEACHERS' DRAWING LESSONS.

MODEL.

STANDARD VII.

BY E. BUFFERY RIDGE,
Head Master, Saffron Hill School of Art.

THE alterations in the Drawing Schedule render Model Drawing essential for all Seventh Standards. Teachers may elect to take (*b*) Model Drawing in Outline, or (*c*) Common Objects and Casts of Ornament in Light and Shade; and as the common objects selected by the inspectors are usually geometrical models, the children must of course be able to draw them correctly.

Model drawing, 'more advanced than in Standard VI.,' can be given in two ways: 1, by placing the objects in more difficult positions; 2, by using more of them.

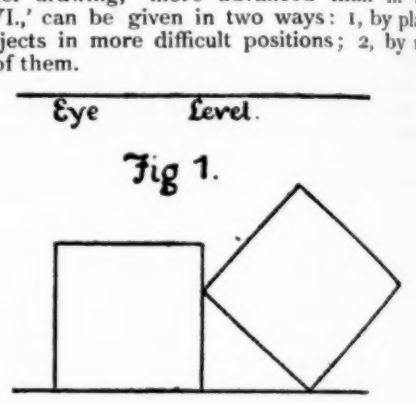

Fig 1.

Fig. 1 is the end elevation of a cube ABCD and a square prism P. The cube has two of its *faces* vertical; the bottom *edge* A rests on the ground, and the edge C rests against the side of the prism. Notice that these two edges (and the other two, B and D) are *horizontal* and *parallel* to the horizontal edges of the prism. The diagonal AB must lean *towards the side on which the cube is propped up*. Then the line CO will be shorter than the line OA.

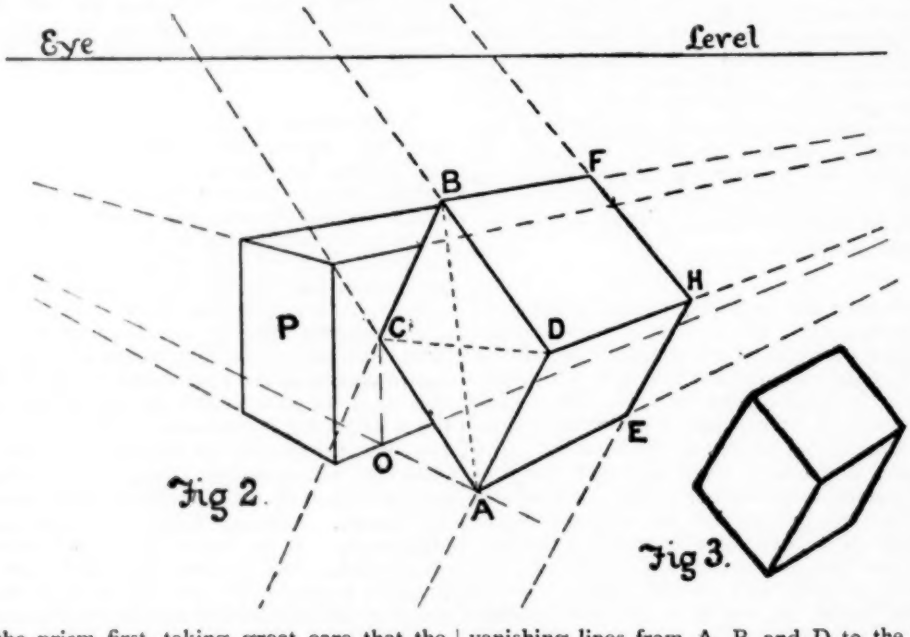

Fig 2.

Fig 3.

Draw the prism first, taking great care that the space between the top of the prism and the eye level is properly proportioned to the height of the prism itself. (See Model Drawing for Standard VI.) Fix point C, drop a perpendicular to O, and draw OA vanishing to the left with the short edges of the prism. Fix A by comparing OA with OC. Join AC and complete the vertical face ABCD, making the near edges AD and BD longer than their opposites, BC and AC. Remember that AB is not vertical—it leans over towards C. Next draw vanishing lines from A, B, and D to the vanishing point of the *long* edges of the prism. Get point H by comparing DH with other lines in the figure, and make AE and BF slightly shorter than DH. The difference between AE and BF is small and uncertain, and may be neglected in first sketching. Join FH and HE.

Revise the drawing before lining-in by a reference to the *three* vanishing points of the cube. One is on the eye level—BF, DH, and AE meet in it. A second is far below—it is the meeting place of BC,

DA, and HE, while the third, above the horizon, is the vanishing point of AC, BD, and FH.

Caution.—Do not make the diagonal CD vanish with OA—*leave it alone.*

The most common fault will be a tilted appearance, as in Fig. 3. This will be caused either by the lines of the prism having been drawn at too great an angle with the horizontal in the first instance, or by DH being too long.

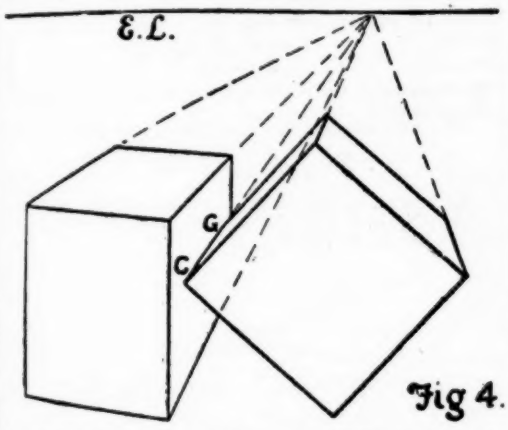

Fig 4.

In Fig. 4 is shown a rather more difficult view, the two top slanting faces of the cube being seen. It has, however, the advantage of showing the line of contact CG between the two objects. The method is exactly the same as in Fig. 2.

CONVERSATIONAL LESSONS IN CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),

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For particulars of the List of Chemicals and PRACTICAL TEACHER Set of Apparatus for working the experiments referred to in these lessons see numbers for January and February 1893.

LESSON XXVI.—SODIUM.

TASTE this white substance, Henry. What do you make of it? It's salt, sir. Well, do not pull such a wry face, for without salt you would soon be eaten up with disease. Every year you eat 20 lbs. of it. Now take your thoughts back to your lesson in hydrogen, and then tell me what I have in this bottle. Ah! I see you have not forgotten. Well, Minnie, what is it? It is the metal sodium, sir. Very true, and you by way of reward shall repeat the experiment we then performed with the metal sodium. I can soon do that, sir. All I have to do will be to cut off a bit of the sodium— Stop, what does that teach us, Albert? That sodium, like potassium, is a very soft metal. Very true. Continue your remarks, Minnie. All I now have to do, sir, is to drop the metal upon the water, when it will combine with the oxygen and set the hydrogen free. Very true; and pray, Bob, what may we learn from the latter part of Minnie's experiment? We learn, sir, that the metal sodium has great affinity for oxygen. Good; and if you recall what we said in our last lesson, you can mention some other proof of that interesting and important property. I am glad to see so many hands up, and will call upon Lilla to explain. The metal sodium, like potassium, is kept under naphtha, which has no oxygen in its composition, because otherwise it would combine with the oxygen of the air and become sodium oxide instead of metallic sodium. Very nicely put; and see, here is ocular demonstration of the truth of your statement. I cut this pellet of sodium and you notice the bright, lustrous appearance of the metal. By-the-bye, what is its colour, Annie? It is silvery white, sir. Very true, but, as in the case of potassium, this does not long continue. See, the lustre has gone, and you now no longer can see the metal, since it is hidden by the film of oxide that has formed upon the cut surface. You can tell me something about the water that has been acted upon by the metal, can you not, Minnie? Oh, yes, sir; the water will now turn vegetable reds blue, and it has a soapy feel. Very true; and before we go any further, Charlie shall test this for himself. Does it feel soapy, Charlie? Yes, sir, and here is the red litmus paper turned quite blue. Quite so; you are not surprised, as we have already seen this experiment performed. What name did we say was applied to bodies able to act in the way just described? Let Bob answer. We called them *alkalis*, sir. Very true; I am glad you have remembered the word. And now I wish all of you to bear in mind that sodium and potassium are called the *metals of the alkalis, i.e.*, the metals whose oxides when added to water give the water alkaline properties. Why did I show you salt and sodium together, Mabel? Because salt contains sodium; it is called sodium chloride, and consists of the elements sodium and chlorine. Quite so, and that is enough in itself to make the metal sodium of great importance; but, as I shall show you later on, common salt is by no means the only important compound of sodium. Like potassium, sodium was only proved to be a metal by Sir Humphry Davy in 1807, the method of preparation being exactly the same as in the case of potassium. Before Davy's time both soda (NaOH) and potash (KOH) were regarded as elements.

Take your platinum wire, Maud, and place it in this solution of salt, and then transfer it to the Bunsen flame. That rich yellow colour which you are all admiring is a proof of the presence of sodium, and as most flames contain more or less of this yellow colour, we have to admit that sodium is present as an impurity on all sides.

What is this that I hold in my hand, Lizzie? Come nearer and examine it. It looks like washing-soda, sir. Yes, that is exactly what it is, and I need not tell you how extremely useful washing-soda is. Chemically considered, it is soda-carbonate. It is difficult to imagine how we should get on without it. How do you think we get it? Do we get it from the ashes of plants, sir, just as we did potash? No, Bob, washing-soda is not so easily obtained. I see I must tell you. Washing-soda is made from common salt. The manufacture of it is one of the oldest and also one of the most important of chemical industries. It is called the alkali manufacture. We are not able to go right from common salt to carbonate of sodium. The process consists of three stages:—

(1) Common salt is converted into sodium sulphate—

$2\,NaCl$	+	H_2SO_4	=	Na_2SO_4	+	$2\,HCl$
common salt		sulphuric acid		salt cake		hydrochloric acid

(2) Sodium sulphate is turned into sodium carbonate by the agency of limestone and carbon—

Na_2SO_4	+	$CaCO_3$	+	$2\,C$	=	Na_2CO_3	+	CaS	+	$2\,CO_2$
salt cake		limestone		coal		soda carbonate		calcium sulphide		carbon dioxide

(3) The soda carbonate is separated from the other bodies and purified.

When you are older, you will learn more about this interesting manufacture of washing soda. Well, Lilla, what is it you wish to ask? I see both soap and glass amongst the things on the table. Has sodium anything to do with them? Yes, both glass and soap must have an alkali as a constituent. I think I told you that soft soap is potash soap, and that all hard soaps have soda. Another more recent and better way to prepare washing-soda from common salt is called the ammonia-soda process. To illustrate this shall be Maud's privilege. Here is a solution of ammonia. To it add common

salt until it is no longer dissolved. Now pass a current of CO_2 through the solution, and after a time you will get a precipitate about which we will talk before it appears. Here is the equation which represents the reaction :—

$NaCl$	+	CO_2	+	NH_4OH	=	$NaHCO_3$	+	NH_4Cl
common salt		carbon dioxide		ammonic hydrate		sodium bicarbonate		sal ammonia

All that we have to do to the bicarbonate in order to convert it into washing-soda is to heat it.

$$2\,NaHCO_3 = Na_2CO_3 + CO_2 + H_2O$$

Yes, Annie, this bicarbonate of soda is the stuff used in cake making.

What is glass made of, sir? Well, that depends upon the kind. One common kind is made of *sand, soda, and chalk.* Well, I think we have learnt enough to show how very important the metal sodium is, and we will conclude our lesson by naming a few of the most useful of the compounds of sodium.

COMPOUNDS OF SODIUM.

Name.	Chemical Formula.	Use.
Common salt (sodium chloride).	$NaCl$ - -	A food from which the HCl of the gastric juice is obtained. Source of all the chlorine used and of washing-soda (etc.).
Washing soda (sodium carbonate).	$Na_2CO_3.10H_2O$	Used as a cleanser.
Bicarbonate of soda (sodium hydrogen carbonate).	$NaHCO_3$ - -	Used in baking.
Glauber's salts (sodium sulphate).	Na_2SO_4 - -	Used as a medicine.
Caustic soda - -	$NaOH$ - -	Used in soap making, glass making, etc.
Chili saltpetre (sodium nitrate).	$NaNO_3$ - -	Used in the manufacture of nitric acid and as a manure.

QUERY COLUMN.

(*a*) Prove that the path of a particle under a central attraction varying inversely as the square of the distance is a conic section.

(*b*) Prove the formula in elliptic motion

$$V^2 = \frac{2\mu}{r} - \frac{\mu}{a}.$$

(*c*) A particle is projected under the influence of such a force (*i.e.*, one varying as the square of the distance) with such a velocity as to describe a parabola; if at the end of the latus rectum the intensity of the force be doubled, determine the position of the other focus and the vertex of the ellipse that will now be described.

Solutions.

(*a*) The law of force being given, the determination of the orbit depends on the solution of a differential equation, for if $P = \mu\phi(u)$, we have

$$\frac{d^2u}{d\theta^2} + u = \frac{\mu}{h^2}\frac{\phi(u)}{u^2}. \quad (1)$$

In the particular case where the attraction varies inversely as the square of the distance, equation (1) becomes

$$P = \frac{\mu}{r^2} = \mu u^2;$$

$$\therefore \frac{d^2u}{d\theta^2} + u = \frac{P}{h^2u^2} = \frac{\mu}{h^2}. \quad (2)$$

Equation (2) determines the path if the law of force be given, and the law of force if the path be given.

Integrating, we have—

$$u - \frac{\mu}{h^2} = A\cos(\theta - \gamma). \quad (3)$$

Equation (3) is the equation of a focal conic. According to the values of the constants A and γ (which are determined from the initial circumstances of the motion), the orbit is an ellipse, parabola, or hyperbola. μ denotes the acceleration at unit distance (called the strength of the centre), and P the attractive force to the fixed centre.

(*b*) The equation to an ellipse is

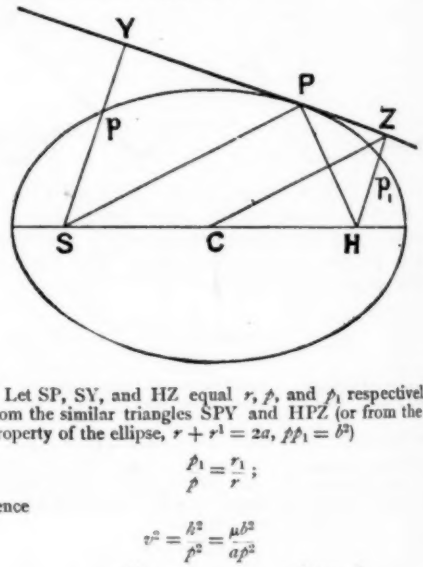
$$u = \frac{1}{r} = \frac{1 + e\cos(\theta - \gamma)}{a(1 - e^2)}, \quad (4)$$

the focus being the origin, and any line drawn through it as prime vector.

Comparing equation (4) and equation (3), we find

$$\frac{\mu}{h^2} = \frac{1}{a(1 - e^2)} = \frac{a}{b^2}. \quad (5)$$

Let v be the velocity for an elliptic orbit; S and H the foci of the ellipse; P any point on the ellipse; SY and HZ perpendiculars on the tangent at P.



Let SP, SY, and HZ equal r, p, and p_1 respectively, then from the similar triangles SPY and HPZ (or from the known property of the ellipse, $r + r^1 = 2a$, $pp_1 = b^2$)

$$\frac{p_1}{p} = \frac{r_1}{r};$$

hence

$$v^2 = \frac{h^2}{p^2} = \frac{\mu b^2}{ap^2}$$

$$= \frac{\mu p p_1}{ap^2} = \frac{\mu p_1}{ap} = \frac{\mu r_1}{ar} = \frac{\mu}{a}\frac{(2a - r)}{r};$$

$$\therefore v^2 = \frac{2\mu}{r} - \frac{\mu}{a}. \quad (6)$$

(*c*) When the absolute force μ is doubled, let R and V represent the distance and velocity respectively at the instant in question; $2a_1$ the major axis of the new orbit; then equation (6) becomes

$$\frac{2\mu}{R} = \frac{4\mu}{R} - \frac{2\mu}{a_1},$$

hence $a_1 = R$. And the new orbit is an ellipse having the extremity of its major axis at the point.

Another method may be used.

$$P = \frac{h^2}{p^3}\frac{dp}{dr},$$

where p is the perpendicular from the centre on the tangent, r is the radius vector at any point.

Let $4m$ be the latus rectum of the parabola.

From the property of the parabola,

$$\frac{1}{p^2} = \frac{1}{mr},$$

$$\frac{2}{p^3}\frac{dp}{dr} = \frac{1}{mr^2};$$

$$\therefore P = \frac{h^2}{2mr^2}.$$

When the force is doubled

$$P = \frac{h^2}{mr^2};$$

$$\therefore \frac{h^2}{mr^2} = \frac{h^2}{p^3}\frac{dp}{dr};$$

or

$$\frac{1}{mr^2} = \frac{1}{p^3}\frac{dp}{dr}.$$

Integrating, we have—

$$\frac{1}{mr} = \frac{1}{2p^2} + \text{constant}.$$

To determine the constant, let a_1 be the value of r at the instant the absolute force is doubled; p being then common to both the parabola and the new path.

$$\frac{1}{ma_1} = \frac{1}{2ma_1} + \text{constant};$$

$$\therefore \text{constant} = \frac{1}{2ma_1}.$$

The equation to the new path is therefore

$$\frac{1}{mr} = \frac{1}{2ma_1} + \frac{1}{2p^2};$$

or

$$\frac{ma_1}{p^2} = \frac{2a_1}{r} - 1. \quad \text{(A)}$$

Equation (A) is the equation to an ellipse major axis $2a_1$, minor axis $2\sqrt{ma_1}$.

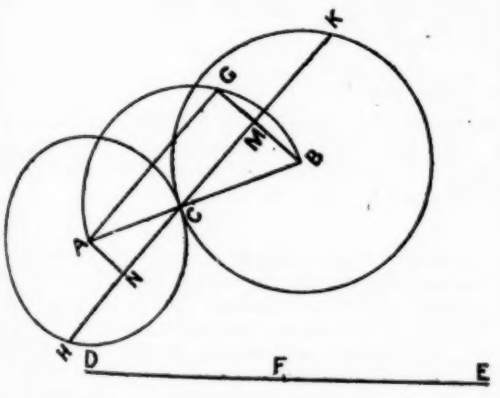
Also the ellipse touches the parabola when $r = a_1$.

The inclination of the major axis to the axis of the parabola is

$$\sin^{-1}\sqrt{\frac{m}{a_1}}.$$

See any of the following:—'Dynamics,' by Besant. 'Dynamics of a Particle': Tait and Steele. 'Dynamics': Williamson and Tarleton.

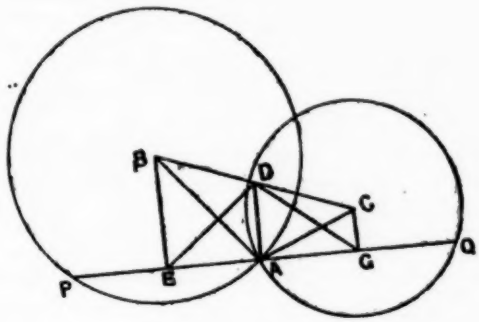
Hopeful.—Two circles touch externally at C; show how to draw a straight line through C to meet the circumferences in H and K respectively, so that HK may equal a given straight line not greater than the sum of the diameters of the circles.



Let A, B be the centres of the circles.

Join A, B, the straight line through which passes through C. Supposing DE to be the given straight line, bisect it in F. On AB describe a semicircle. From A, with radius DF, cut the semicircle in G. Join BG. Through C draw HCK parallel to AG, and terminated on either side by the circumference of one of the circles. Then HCK is the straight line required. Let HCK cut GB in M. From A draw AN parallel to GM to meet HCK in N. Then ANMG is a parallelogram, and since one of its angles AGM is a right angle, being the angle in a semicircle, all its angles are right angles (Bk. I.). Therefore ANM is a right angle, and NC = NH (III.). Similarly CM = MK. Therefore NM is the half of HCK. But NM = AG = DF, which is the half of DE. Therefore the whole line HCK equals the whole line DE.

L.E.X.—Two unequal circles intersect at A; show how to draw a straight line PAQ cutting the one circumference in P and the other in Q so that PA may equal AQ.



Let B, C, be the centres of the circles.

Bisect CB in D. Through A draw PAQ perpendicular to DA, and meeting the circumferences of the circles in P and Q. Then PA = AQ. From B let fall the perpendicular BE on PA, and from C let fall the perpendicular CG on AQ. Join BA, DE, AC, DG. Then BE, DA, CG are all parallel.

Since BD = DC, triangle BAD = triangle CAD. But since the lines BE, DA, CG are all parallel, triangle DAE = triangle BAD, and triangle DAG = triangle CAD. Therefore triangle DAE = triangle DAG, and AE = AG. But AE is one half of AP, and AG is one half of AQ. Therefore PA = AQ.

W. M. Stuart.—Find the ratio which the number of numbers of five different digits of which zero is not one, bears to the number of numbers of five different digits of which zero is one.

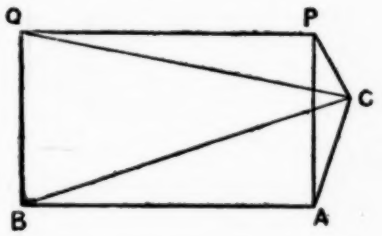
Number of numbers of five different digits of which zero is not one equals the number of permutations of five things taken all together = $\underline{|5}$.

But if zero is one of the digits, it will have no value if placed first in a number. The numbers which can be made out of the four other digits = $\underline{|4}$. Out of each of these numbers, four different numbers of five digits each may be formed by putting 0 successively in the fifth, fourth, third, and second place. Thus, out of the number 1238, we can form the four different numbers 12380, 12308, 12038, and 10238 by the addition of the digit 0. Therefore, out of $\underline{|4}$ numbers of four digits, we can form $\underline{|4} \times 4$ numbers of five digits by the addition of 0.

Therefore the ratio required $= \frac{\underline{|5}}{\underline{|4} \times 4} = \frac{5 \times 4 \times 3 \times 2}{4 \times 4 \times 3 \times 2} = \frac{5}{4}$

$= 5 : 4$.

W. M. Stuart.—A, B, C are three points in a horizontal plane, the angle BAC is a right angle, and the length of AC is 1,000 ft.; P and Q are points vertically over A and B, and the line PQ is horizontal; the angle of vertical elevation of P at C is 52° 40′, and that of Q at C is 34° 43′; find the distance PQ.



The angle ACP = 52° 40′, the angle QCB = 34° 43′, and the angle CQB = 55° 17′.

$$\frac{PA}{AC} = \tan ACP = \tan 52° 40';$$

$$\therefore PA = AC \tan 52° 40'.$$

But BQ = PA; ∴ BQ = AC tan 52° 40′.

$$\frac{BC}{BQ} = \frac{1}{\tan BCQ} = \frac{1}{\tan 34° 43'}.$$

$$\therefore BC = \frac{BQ}{\tan 34° 43'} = \frac{AC \tan 52° 40'}{\tan 34° 43'},$$

$$\sin CBA = \frac{AC}{BC} = AC \div \frac{AC \tan 52° 40'}{\tan 34° 43'}$$

$$= \frac{\tan 34° 43'}{\tan 52° 40'}.$$

L sin CBA = L tan 34° 43′ − L tan 52° 40′ + 10

= 9·7230102.

∴ By the tables CBA = 31° 54′ 5″.

∴ BCA = 58° 5′ 55″.

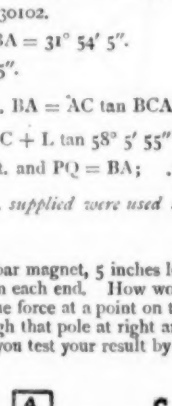
$\frac{BA}{AC}$ = tan BCA; ∴ BA = AC tan BCA = AC tan 58° 5′ 55″;

∴ log BA = log AC + L tan 58° 5′ 55″ − 10 = 3·2058755;

∴ BA = 1606·48 ft. and PQ = BA; ∴ PQ = 1606·48 ft.

N.B.—*Only the logs. supplied were used in the working of the above.*

Electro.—A straight bar magnet, 5 inches long, is laid on a table. Its poles are ½ inch from each end. How would you find by calculation the direction of the force at a point on the table 3 inches from one pole in a line through that pole at right angles to the axis of the magnet? How would you test your result by experiment?



Let A and B be the two poles of the bar magnet. Let C be the point, 3 inches to the right of A.

Each pole exerts a force on C, inversely proportional to the square of the distance.

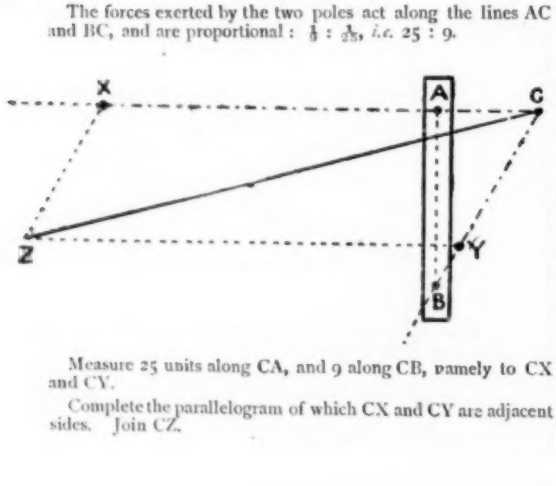
Since ABC is a right angled triangle,

and AC = 3″,

and AB = 4″,

∴ BC = 5″.

The forces exerted by the two poles act along the lines AC and BC, and are proportional: $\frac{1}{9} : \frac{1}{25}$, *i.e.* 25 : 9.



Measure 25 units along CA, and 9 along CB, namely to CX and CY.

Complete the parallelogram of which CX and CY are adjacent sides. Join CZ.

Then the diagonal CZ will represent the direction of the force exerted by the magnet on the point C.

To prove the truth of the above experimentally, place a magnet of very small dimensions, capable of moving in a horizontal plane, at the point C. The axis of this small magnet will be found to take the direction CZ.

We are compelled by want of space to hold over some answers to queries till next month.—Ed.

LEGAL AND CODE QUERIES COLUMN.

RULES.

1. All communications must be addressed 'Legal Editor, Practical Teacher, Froebel House, St. Andrew's Hill, Doctors' Commons', E.C.,' and must be accompanied by our 'coupon,' duly filled up.
2. Replies will be given *only* in this column, except under the conditions named in Rule 3.
3. If any reader desires a reply by post, such can be forwarded by enclosing, in addition to the coupon, a stamped addressed envelope and either stamps or a Postal Order to the value of one shilling.
4. No original documents should be forwarded, but copies only. We cannot hold ourselves responsible for any losses which occur through non-observance of this rule.

COMING MEN.

XVI.—MR. H. M. COHEN,

Rea Street Board School, Birmingham.

Member of the Committee of the National Federation of Assistant Teachers; Co-Secretary of the Birmingham N.U.T. Association; Member of the Council of the Midland District Union.

The metropolis of the Midlands has contributed in no small degree to the educational progress of the country. On two occasions during the existence of the N.U.T. has that organisation received a welcome for its Annual Conference from the Birmingham Teachers. Coming to more recent times, every Class Teacher must have still fresh in his memory the unbounded hospitality and cordial greeting which all classes of Teachers in Birmingham extended to the representatives assembled at the Assistant Teachers' Conference in October last. Apart from the veterans in Union work who hail from the city, there is to be found a band of young enthusiasts whose energies have been of incalculable value to the cause of Unionism of late. The most representative Class Teacher to be found in Birmingham is without doubt the subject of our present sketch. His labours for the emancipation of the particular section of the profession to which he belongs alone entitle him to a

position in the front rank of Union workers, though his energies have by no means been confined to this one object.

Mr. Cohen is a native of Birmingham, having seen the light for the first time at that city in 1867. He passed the entrance examination to King Edward's School, and on the introduction of fees to that establishment was successful in obtaining a Scholarship, which obviated the necessity of such fees as were instituted. His career at this school was of an extremely creditable character. During his final year he carried off no less than five prizes, including the 'Vardy' prize, the highest distinction to be won in the school. From King Edward's School Mr. Cohen proceeded to the Smith Street Board School as a Pupil Teacher, and here he completed his necessary term of apprenticeship. For twelve months he was engaged in the capacity of Ex-P.T. Assistant at the Osler Street Board School; and from thence he proceeded to the Training College at Cheltenham. Here he spent the years 1887–8, and all old 'Chelts' will appreciate the popularity which he enjoyed when they are informed that he was elected to fill the honoured office of 'Bishop.'

He secured a position in the first division of the Certificate list, and again accepted service under the Board of his native town, being appointed as a Class Master in the Hutton Street Board School. For three years Mr. Cohen fulfilled his duties at this school, and was then promoted to a chief Assistantship in his present school.

On entering the service of the Birmingham Board after leaving College, Mr. Cohen found abundant scope for the energy and ability in organisation work which are such marked characteristics of the man. The practice of the Board at this time was to recognise but one Certificated Class Teacher in a department. All other Class Teachers, whether certified or not, were classed as Ex-P.T. Assistants and remunerated as such, the minimum salary being £55 and the maximum £70.

There was evidently need for much enlightenment, and Mr. Cohen undertook the task of providing it. His methods may be of service to others who are under the unfortunate necessity of having to take steps to secure reasonable conditions of service.

A meeting of the teachers affected by the Board's regulation was held, a memorial drafted, and the members of the School Board individually interviewed. The aid of the Press was sought by placing the exact condition of circumstances before the editors of the local journals. The local Class Teachers' organisation undertook the duty of forwarding the memorial, and the result was most gratifying. The School Board recognised the Teachers' diploma in every case, and established a minimum of £70 or £75 per annum for Certificated Class Teachers with a maximum of £100.

This success was due, to a very large extent, to the untiring perseverance and determination of Mr. Cohen. At the next annual meeting of the Birmingham Assistant Teachers' Association he was unanimously elected Secretary, and continued to fill that office until the dissolution of the Association took place this year. The Birmingham Assistant Teachers' Association is now merged into the Birmingham Board Teachers' Association.

During the period in which Mr. Cohen held the secretarial office, many reforms were accomplished. The position of the Class Teacher in Birmingham underwent a much-desired change. This was owing to action taken from time to time by the Association, and it is well known on what official, in any association, the essential labour falls.

When the awakening of the Class Teachers of the country brought about the memorable gathering at Sheffield, Mr. Cohen represented his association and was elected a member of the Assistant Teachers' National Committee. He served in this capacity continuously, until the Committee was superseded by the formation of the National Federation of Assistant Teachers. At the Derby Conference Mr. Cohen was not successful in obtaining a position on the Federal Committee, but was 'co-opted' by the Committee shortly afterwards. He has attended all the Conferences of Assistant Teachers which have been held, viz., Sheffield, Nottingham, Derby, and Birmingham.

When the Federation visited Birmingham last year he was, as General Conference Secretary, responsible for the necessary local arrangements. Those who were fortunate enough to be present at that Conference can form some idea of the magnitude of Mr. Cohen's labours.

He possesses a broad grasp of all educational questions, and brings practical advice into the deliberations of the organisations with which he is connected. His capacity for work is almost without limit, and the Class Teachers owe him a debt of gratitude for his services to their cause.

As we have previously observed, Mr. Cohen's efforts have not been limited to the betterment of his own professional section. He was a member of the N.U.T. before he entered Training College, and he

rejoined the Union on returning to Birmingham. It was, of course, but a natural outcome of events that, after leading the local van on behalf of the Class Teachers with such success, he should attain some prominence in connection with the Birmingham branch of the N.U.T.

For the past four years he has been a member of the Committee of this association, during three of which he acted as District Secretary.

Two years ago he was elected co-Secretary with Mr. York, and, with this gentleman, has made great and successful efforts to materially increase the Union's membership in the locality. He takes an active interest in the Benevolent and Orphan Funds of the Union, and has been a member of the Birmingham Local Board ever since its formation.

Mr. Cohen is an advocate of the system of District Unions which is now developing. He was intimately connected with the movement which led to the establishment of the newly-formed Midland District Union. He is now a member of the Council of this District Union. In connection with the organisation work of the Birmingham Association he has repeatedly addressed meetings, chiefly of non-unionists, with the object of bringing his hearers into the fold.

The Birmingham Association found a capable representative in him at the Oxford and Manchester Conferences of the N.U.T.

When the Birmingham School Board considered the question of Teachers' Superannuation, they requested the various classes of teachers in their service to furnish a deputation to explain their views upon the subject. Mr. Cohen was the chosen one of the Class Teachers. He also accomplished praiseworthy service in appearing before the Board on the vexed question of Corporal Punishment. No reference can be made to the Teachers of Birmingham without arousing the recollection of the phenomenal success of their candidate at the last School Board election. Mr. Ansell, the Birmingham Teachers' representative, polled no less than 146,009 votes, this number being in excess of the total votes recorded for the eight members of the successful Liberal party.

Mr. Cohen had an active share in the preliminary arrangements for that contest. He was a member of the Election Committee, but unfortunately, the severe strain brought about by his manifold exertions told upon his health during the election campaign and he was rendered unable to continue his efforts. The Teachers in the service of the Birmingham Board are now organised in one powerful association—the Birmingham Board Teachers' Association. Mr. Cohen is a member of the Committee of this body.

He has a sincere regard for his *alma mater*, and is the Minuting Secretary to the Midland Chelt Club.

His occasional contributions to current literature denote his knowledge of detail in educational matters. The busiest man, as a rule, can find the greatest amount of time to devote to various objects, and Mr. Cohen is not unknown outside his professional arena.

He is a splendid example of the working Unionist. The success of the various organisations of Teachers has been attained by the unselfish devotion of willing and voluntary workers. To this community the thanks of every teacher in the country are due. Without their existence reforms would never be realised, and their enthusiasm and zeal have sufficient contagion about them to influence many who would remain passive and negligent to the interests of their profession.

At the present juncture the services of these workers are of priceless value, and it is but a modest tribute that we pay to Mr. Cohen when we observe that he occupies a distinguished position in the ranks of those who devote not only considerable time and energy to the cause of their fellows, but in addition are called upon to make no small amount of sacrifices at the expense of themselves.

Mr. Cohen is not by any means a veteran in the service of national education, but as a young warrior he gives evidence of such promise, that we confidently look forward to a continuance of his useful work with the conviction that he will realise such a position as will amply justify the prophecy contained in the title of this series of articles.

GREGORY'S PHYSIOGRAPHIES

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Our Science Section.

SOLUTIONS TO QUESTIONS IN THEORETICAL MECHANICS, MAY, 1895.

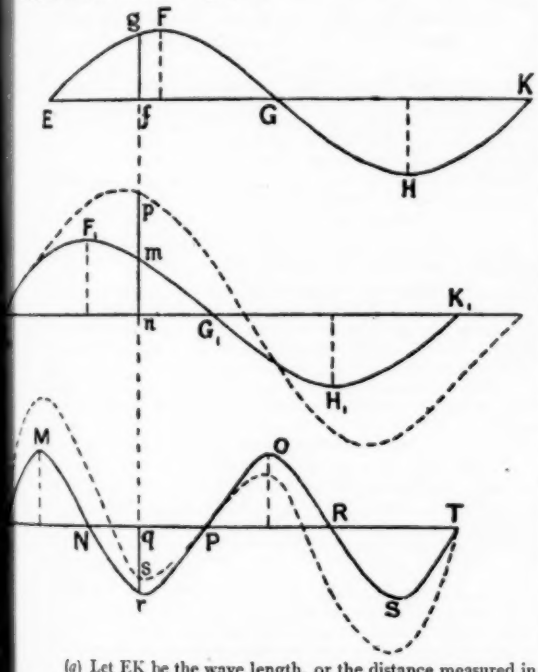
FLUIDS—ADVANCED STAGE.

BY F. CASTLE, M.I.M.E.

(*Continued from September issue.*)

32. (*a*) When a line of aërial particles transmits two distinct sets of vibrations, show how to represent graphically the successive displacements of any one of the particles.

(*b*) Draw the diagram carefully when the time of one vibration is half that of the other. (30.)



(*a*) Let EK be the wave length, or the distance measured in the direction in which the waves are travelling, between any particle and the next particle in the same *phase*. The time taken by any particle to go through one complete cycle of motions is called the periodic time, or usually the *period*, and is the same for all the particles.

Thus in the diagram, EK is the wave length, F and H the points at which the displacement is greatest, and EGK the points at which the displacement is zero. The curve EFGHK is known as the curve of sines and can easily be drawn.

Hence if two distinct sets of vibrations coexist along a line of aërial particles, the resultant motion can be determined by drawing the curve EFGHK for one wave, and $E_1F_1G_1H_1K_1$ for the other, then the algebraic sum of the ordinates at any point will give the resultant displacement at that point; thus at point *n* let *nm* be drawn meeting curve $E_1F_1G_1$ at *m*, and *fg* meeting curve EFG in *g*; then $np = nm + fg$ and gives the point required; in a similar manner other points can be determined and the dotted curve drawn.

(*b*) When the time of one vibration is half the other, the curve LMN . . . . is obtained, the wave length LP equal to half EK, the resultant curve as before can be obtained by adding algebraically the ordinates at any point; thus $qs = nm - rq$ gives point *s*; proceeding in this manner any number of points can be obtained and the dotted curve drawn.

NOTES ON THEORETICAL MECHANICS.

ADVANCED AND HONOURS STAGES.

BY F. CASTLE, M.I.M.E.

In the previous articles it has been shown that any system of forces acting upon a rigid body can be reduced to a *single resultant force* in combination with a *single resultant couple*; the condition of equilibrium requires that each must be zero.

If a force acting on a body causes it to move into a different position, or changes the form or size of the body by overcoming the resistances which oppose the change, the force is said to do *work* on the body; thus work is done by a force when its point of application is moving in the direction in which the force acts. The amount of work is measured by the product of the force multiplied by the distance through which it acts, or the resistance multiplied by the space through which it is overcome. Thus in the case of a weight raised vertically, the resistance is due to the action of gravity, and the work done is the product of the weight multiplied by the distance through which it is raised.

The *unit of work* is the product of unit force multiplied by unit distance; the unit distance is usually a foot, but the unit force may be the poundal pound, ton, etc., and the work done is said to be in foot poundals, foot pounds, etc.

In the C.G.S. system the unit of work is called an erg, and is the work done by a dyne through a distance of a centimetre.

Work done on a body by a force is always shown by an increase in either *potential energy* or *kinetic energy*, and we obtain a numerical estimate from the *second law of motion*. Change of motion is proportional to the impressed force, and takes place in the direction of the straight line in which the force acts. Expressing this law in terms of *impulse* and *momentum*, we have

$$Ft = M(V - v), \quad (1)$$

where F is the force in poundals, t the time in seconds, M the mass of the body in pounds, V and v the velocities in ft. per sec. of the body at the end and beginning (of the interval) respectively.

From equation (1), when t is unity,

$$F = Mf,$$

where f is the acceleration produced.

The distance s moved through in t seconds by a body uniformly accelerated from v to V is

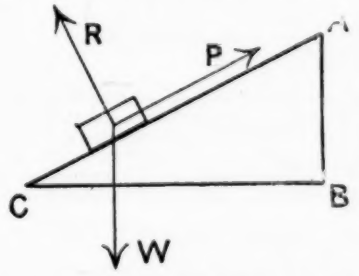
$$\frac{V + v}{2} \times t,$$

where $\frac{V + v}{2}$ is the *mean velocity* (or the arithmetical mean of the velocity at the beginning and at the end).

Multiplying both sides of equation (1) by $\frac{V + v}{2}$, we have

$$Fs = \tfrac{1}{2}M(V^2 - v^2).$$

The expression on the left hand is the work done by the force, the result being that the kinetic energy $\frac{1}{2}Mv^2$ is changed to $\frac{1}{2}MV^2$.

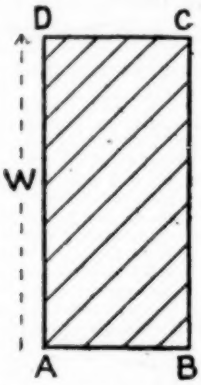


Thus the change in the kinetic energy of the body is equal to the work done by the force.

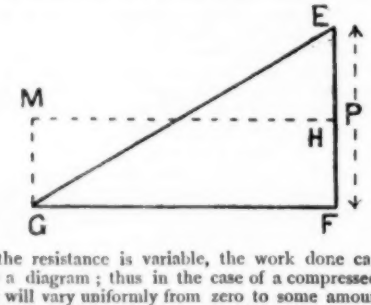
It is important to note that the work done in raising a weight is the same in amount whether raised in a vertical direction or obliquely. Thus if a weight be raised along a smooth inclined plane ABC, the work done in raising the weight W from C to A is W × AB. The force P must move from C to A, and CA is greater than AB; but from the triangle of forces it is easily seen that P : W :: AB : AC.

$$\therefore P = \frac{AB}{AC}W. \quad (2)$$

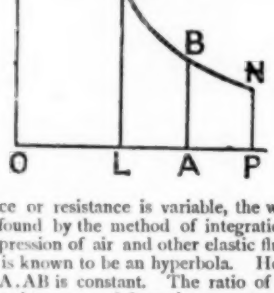
$$\therefore P \times AC = W \times AB.$$



The work done by P from C to A is P × CA, representing this graphically; the diagram of work is a rectangle ABCD as shown, having its vertical side equal to W, and the horizontal side AB equal to the distance through which W is raised.



When the resistance is variable, the work done can easily be shown by a diagram; thus in the case of a compressed spring the resistance will vary uniformly from zero to some amount P, represented by FE, the line of resistance will be GE, and GF the compression of the spring; the work done will be the area of the triangle EFG, and may be shown by the area of the rectangle FPMG, where FP is ½ FE.



When the force or resistance is variable, the work done over a space s must be found by the method of integration. Thus in the cases of the compression of air and other elastic fluids, the curve of resistance MBN is known to be an hyperbola. Hence at any point B the product OA.AB is constant. The ratio of compression OP to OL is usually written r; and from the geometry of the hyperbola we have

Area of curve is OA.OB multiplied by $\log_e r$,

or if OA = v, and AB = p,

$\therefore$ area of curve = $pv \log_e r$.

For many purposes only an approximate result is necessary; this is obtained by drawing a number of ordinates, LM, AB, PN.....

Measuring the length of each ordinate to scale, adding the amounts so obtained together, and dividing by the number of ordinates, this gives approximately the mean pressure, and multiplying the mean pressure by the distance moved through, the work done is obtained.

A better approximation is obtained when Simpson's Rule is used. In this case the number of ordinates is an odd number, 3, 5, 7, 9, etc., the distances between them are equal. Then to obtain the area of the diagram MNPL, add together the first and last ordinates, twice the sum of all the other odd ordinates, and four times the sum of all the even ordinates, and multiply the result by one-third of the common distance between two adjacent ordinates.

The following example will make this clear :—

(*a*) Draw a line A*x*, and take in it five equidistant points, B, C, D, E, F. Suppose a force (P) to act along A*x*, and that its values at the points B, C, D, E, F, are respectively 50, 35, 28, 25, 24 lbs., let the distances BC.CD ..... represent 3 ft. apiece; draw a diagram of the work done by the force, and calculate by Simpson's Rule in foot pounds the work done by the force while acting from B to F.

(*b*) Find also what the result would have been if no more than the values of P at B, D, F, had been given.

(*a*) Work done = $\{50 + 24 + 2(28) + 4(35 + 25)\} \frac{1}{3} \times 3$
= 370 ft. lbs.

(*b*) If only the values at B, D, and F had been given.
Work done = $(50 + 24 + 4 \times 28) \frac{1}{3} \times 6$
= 372 ft. lbs.

The example gives a good instance of the superior accuracy of Simpson's Rule, if in the above the area of each portion be assumed to be a trapezoid. The trapezoidal rule gives 375 ft. lbs. in the first case, and 390 ft. pds. in the second.

The work done in raising a number of weights, w_1, w_2, w_3 + ... through distances h_1, h_2, h_3....., is the sum of the works done in raising each weight separately.

$\therefore$ Work done = $w_1h_1 + w_2h_2 + w_3h_3 + ...$

If h denote the height to which the centre of gravity of the weights is raised, and W the total weight; then

Work done = $Wh = w_1h_1 + w_2h_2 + w_3h_3 + ...$

As an example, the work done in emptying the water from a well (assuming no water to enter the well during the operation) would be found by multiplying the weight of the water by the distance to which the centre of gravity of the water is lifted.

Power is the rate of doing work, and an agent doing 33,000 ft. pds. of work in one minute is said to work at the rate of one horse-power.

Questions—Advanced Stage.

1. The mass of a particle is M lbs., and its velocity V ft. a second; find the number of foot pounds of work it can do against a resistance. A particle weighs 10 lbs., and moves at the rate of 1,250 ft. per sec.; find the distance through which it could overcome a resistance of one million pounds. (1888.)

Ans. 24 feet.

2. A shaft 560 feet deep, and 5 feet in diameter, is full of water; how many foot pounds of work are required to empty it, and how long would it take an engine of 3½ horse-power to do the work? (N.B.—Of course it is assumed that there is no flow of water into the shaft.) You may take $\pi = 3\frac{1}{7}$. (1887.)

Ans. 192,500,000 foot pds.; 1,666⅔ minutes.

3. Find an expression for the whole amount of work done in raising several weights through different heights.

A uniform beam weighs 1,000 lbs., and is 20 feet long; it hangs by one end, round which it can turn freely; how many foot pounds of work must be done to raise it from its lowest to its highest position? (1890.) Ans. 20,000 foot pds.

4. A particle, whose mass is 5 lbs., moves at the rate of 20 feet a second; express its kinetic energy in foot poundals. If it moves over a distance of 30 feet against a constant resistance (R), and its velocity is thereby reduced to 15 feet a second, find R in poundals. (1892.)

5. A quantity of air, which occupies a volume of 50 cubic feet under a pressure of 15 lbs. per square inch, is allowed to expand at a constant temperature to 60 cubic feet; find the number of foot pounds of work done. (Hyp. log 1·2 = 0·1823216.) (1892.)

Solution—

$p = 15 \times 144 = 2160$;

$V = 60$; $v = 50$; $\therefore \frac{V}{v} = r = 1{\cdot}2$.

Work done = $pv \log_e r = 2160 \times 50 \times {\cdot}1823216$
= 19690·7 foot pds.

6. O, A, B, are three points in order along a line Ox; AH is drawn at right angles to Ox; P is a force acting in the direction O to x, and its point of application moves in the direction O to x; the magnitude of P varies inversely as the distance of its point of application from O; given that its magnitude at A is represented by AH, show how to draw a diagram of the work done while the point of application moves from A to B. If OA = 1 ft., OB = 9 ft., AH = 12 lbs., draw the diagram of work, and from it determine approximately the number of foot pounds of work done by the force. (1893.)

Ans. By integration 26·37; by Simpson's Rule 26·52; by rough method 27·28 ft. lbs.

7. Find the number of foot pounds of work required to wind up a given chain, which hangs by one end. (1889.)

Ans. $\frac{W l^2}{2}$; where W = weight of one foot of chain; l = length of chain.

8. If the mass of a circular lamina of uniform density be 100 lbs., its diameter $3\frac{1}{2}$ feet, and if it turns round the axis 120 times a minute, find its kinetic energy (*a*) in foot poundals; (*b*) in foot pounds ($\pi = 3\frac{1}{7}$, $g = 32$). (1889.)

Ans. (*a*) 12,100; (*b*) $378\frac{1}{2}$.

HONOURS PHYSIOGRAPHY NOTES.

BY A. M. DAVIES, B.SC. (LOND.), F.G.S.,
Late Demonstrator in Geology at the Royal College of Science.

The Permian Glacial Period.

The believers in the theory that explains the Glacial Period by astronomical changes of a recurrent character (as the precession of the equinoxes, etc.) have naturally always expected to find some evidence of the periodic recurrence of similar conditions in geological times. The only satisfactory case for the existence of glacial conditions is found in the Upper Carboniferous or Permian formations. The late Sir Andrew Ramsay long ago called attention to the peculiar breccias in the Permian rocks of the Midland counties, in which scratched blocks were found, and which were not unlike moraine-deposits in character. Since then, Indian and Australian geologists have found very much clearer evidence of ice-action in deposits of Upper Carboniferous age in their countries. Quite recently an Indian geologist, Mr. Oldham, has examined the English deposits in the light of Indian experience, and has come to important conclusions. He finds that the Midland breccias are subaerially formed stream-deposits, the materials of which have not travelled far, though they are distinctly waterworn. The scratchings on the blocks are not to any extent due, as has been suggested, to earth-movements subsequent to their deposition, but to previous agencies, of which glacier-ice is the most probable one.

Several points arise out of this, and have been discussed. In the first place the exact age of the English deposits, on the more satisfactory time-scale that can be established in other parts of the earth, is uncertain. They are commonly called Permian, but a good deal of evidence has lately been brought forward in favour of the placing of much of our 'Permian' formation, especially in the Midland counties, in the uppermost portion of the Carboniferous. This renders it possible that the English glacial deposits may be of the same age as the Indian and Australian ones, and if so, the wide extent of glacial conditions over the earth's surface is very striking. It is quite possible, however, that the British glaciers may have been quite local, and they alone need no more indicate the existence of an ice-age than the glaciers of the Alps indicate that we are living in an ice-age now. At the end of Carboniferous time we know that great earth-movements took place in the Southern British and Central European areas by which an extensive mountain-chain was formed, and it is quite possible that local glaciers on the northern flanks of that chain may have scratched the blocks found in the Midland breccias.

Mr. Oldham, indeed, comments on the similarity of these breccias to the 'great gravel-fans that are found everywhere along the foot of the hill-ranges of the drier parts of Western and Central Asia.' Whether an exceptionally cold climate was necessary to produce glaciers in the British area at that time must depend on the relative height of the land above sea-level, and that can scarcely be settled, though it is less likely to have been highly-elevated ground in Upper Carboniferous than in Permian times. On the whole the balance of evidence is certainly in favour of a wide-spread cold climate at the end of the Carboniferous period.

Internal Flow of Glacier Ice.

Professor Sollas has recently described some experiments made with 'cobbler's wax,' that throw some light on the internal flow of viscous substances, and have an important bearing on the transport of boulders by glaciers. The experiments show that the flow is not confined to the higher strata of the wax, even when there is a vertical barrier across the course of the lower strata: the motion takes place in such a way that the lower layers curve up and eventually surmount the barrier, so that foreign materials deposited in the wax are found to be raised in level under these circumstances in the course of what is, of course, a down-hill movement on the whole. This serves to explain the occurrence of boulders that are evidently ice-borne and found at a higher level than the rock from which they must have been derived. The best instance of this is in the Isle of Man, where granite boulders, evidently derived from a mountain reaching less than 700 feet above the sea-level, are found on another mountain at nearly 1,600 feet. Again, the well-known granite of Shap, in Westmoreland, whose large pink felspars make it at once valuable as an ornamental stone and easily identified with certainty, is scattered in the form of boulders all over the north of England, and they have been traced right up across the highest part of the Pennines and down on the opposite side. Formerly the only explanation that could be suggested was the transport of boulders by floating icebergs during a time of submergence—a very inadequate explanation. But of late years the possibility of transport of material by land ice from lower to higher levels has been strongly urged by the younger school of glacialists, who incline to a disbelief in any serious submergence of Britain during the glacial period. For example, the famous shell-beds found at over 1,000 feet above the sea on Moel Tryfaen, near Macclesfield, near Oswestry, and elsewhere are regarded by them as derived from the Irish Sea, and carried up by an extensive ice-sheet to their present level. There is much detailed evidence in favour of this view, which cannot well be summarized.

In one respect the conditions of the experiment with cobbler's wax fall short of those of a glacier or ice-sheet: the former is devoid of the 'ablation and turgescence' which are found in the latter. By ablation is meant the continual melting of the surface of the glacier in the day time, especially in summer. The water so formed finds its way down all cracks to the bottom of the glacier, where it eventually freezes again, so that new ice is being formed in this manner, and the whole thickness of the glacier undergoes a very slow circulation (turgescence). By this means stones at the bottom of a glacier may be frozen into the new ice formed and gradually raised to the surface. This action greatly increases the possibility of boulders being raised to above their original level. That it really does occur is unquestionably proved by the appearance of surface-moraines rising up from within the ice, in Switzerland and elsewhere. Still more extensive observations of the same phenomena have been made on the ice-sheet of Greenland by Professor T. C. Chamberlin of Chicago.

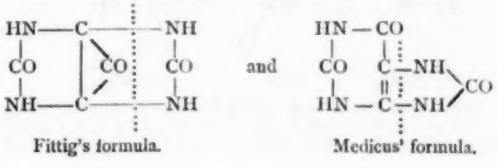
ORGANIC CHEMISTRY NOTES.

BY J. T. HEWITT, M.A., D.SC., PH.D.,
Professor of Chemistry, People's Palace Technical Schools.

Many naturally occurring compounds have to be included amongst the closed-chain substances we have lately considered; such, for instance, are the uric acid derivatives and the greater number of the alkaloids.

Uric acid was discovered by Scheele in 1766, though the name *acid urique* was first assigned to it by Fourcroy in 1799. The substance occurs in the urine of most animals; it can, however, be readily prepared from guano, which is first treated with hydrochloric acid to remove phosphates, oxalates, and carbonates, the residue being then boiled with an alkali (caustic soda), and the uric acid precipitated from the clear solution by addition of hydrochloric acid.

The empirical formula of uric acid is $C_5H_4N_4O_3$; and although it gives metallic salts by replacement of its hydrogen atoms by metallic atoms, it however contains no carboxyl (COOH) groups, the replacement taking place in the hydrogen of imido groups (NH). Two formulæ have been proposed for the compound, viz. :—

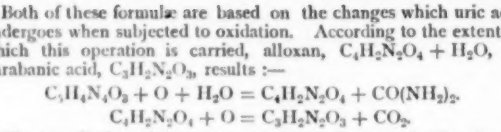


Fittig's formula. Medicus' formula.

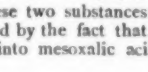
Both of these formulæ are based on the changes which uric acid undergoes when subjected to oxidation. According to the extent to which this operation is carried, alloxan, $C_4H_2N_2O_4 + H_2O$, or parabanic acid, $C_3H_2N_2O_3$, results :—

$$C_5H_4N_4O_3 + O + H_2O = C_4H_2N_2O_4 + CO(NH_2)_2.$$
$$C_4H_2N_2O_4 + O = C_3H_2N_2O_3 + CO_2.$$

The constitution of these two substances has been fixed ; alloxan is mesoxalyl urea, proved by the fact that when boiled with fixed alkalies it decomposes into mesoxalic acid and urea according to the equation—



Parabanic acid is oxalyl-urea,



proved by Ponomarew, who treated a mixture of oxalic acid and urea with phosphorus trichloride. The splitting of uric acid into alloxan and urea on oxidation is equally well explained by the formulæ of Fittig and of Medicus ; to decide between the two further data are necessary. (Note the dotted lines shown on the formulæ of Fittig and Medicus ; these represent the position in the molecule where the splitting takes place.) Fittig's formula is symmetrical, and all the hydrogen atoms must have the same value ; whilst in the formula of Medicus it is evident that the hydrogen atoms are not symmetrically arranged in the molecule ; hence if it were found possible to prepare more than one methyluric acid, $C_5H_3(CH_3)N_4O_3$, Fittig's formula would be definitely disproved, and that of Medicus rendered very probable.

This proof has now been given by Fischer (*Ber.* 17. 330 and 1777), who prepared a methyluric acid differing from the α-methyluric acid prepared by Hill (*Ber.* 9. 370)—who acted with methyl iodide and ether on acid lead urate, $Pb(C_5H_3N_4O_3)_2$, at a temperature of 150°–160°. Hill's methyluric acid gives a mixture of methylalloxan and urea on oxidation with chlorate of potash and hydrochloric acid.

$$C_5H_3(CH_3)N_4O_3 + H_2O + O = C_4H(CH_3)N_2O_4 + CO(NH_2)_2.$$

Fischer's β-methyluric acid was obtained mixed with dimethyluric acid by acting with methyl iodide on lead urate, $PbC_5H_2N_4O_3$, for thirty hours at 100°. By heating this raw product for nine hours at 130° with an excess of phosphorus pentachloride and phosphorus oxychloride, a compound which Fischer called dichloroxymethylpurin is produced.

$$C_5H_3(CH_3)N_4O_3 + 2PCl_5 = C_5H(CH_3)Cl_2N_4O + 2POCl_3 + 2HCl.$$

The purified compound yields pure β-methyluric acid when heated with hydrochloric acid to 140°.

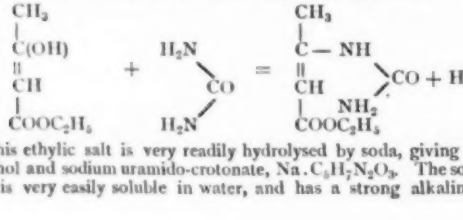
This β-methyluric acid differs from Hill's α-methyluric acid, in that when it is oxidised by nitric acid or chlorine water, alloxan and methyl urea are produced. Thus we see that Fittig's formula for uric acid must be wrong, and that of Medicus is most probably correct.

Medicus' formula has been confirmed by Behrend's synthesis of uric acid (*Annalen*, 228. 1).

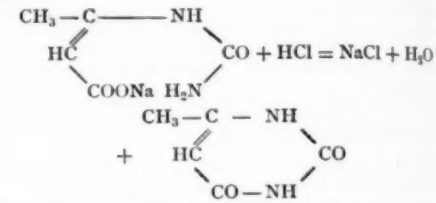
Previously to this, Horbaczewski had obtained small quantities of uric acid, firstly, by rapidly heating glycine with ten times its weight of urea to 200°–230° ; secondly, from urea and trichlorlactamide. The equations in the two cases are :—

$$NH_2.CH_2.CO_2H + 3CO(NH_2)_2 = C_5H_4N_4O_3 + 3NH_3 + 2H_2O.$$
$$CCl_3.CHOH.CONH_2 + 2CO(NH_2)_2 = C_5H_4N_4O_3 + H_2O + NH_4Cl + 2HCl.$$

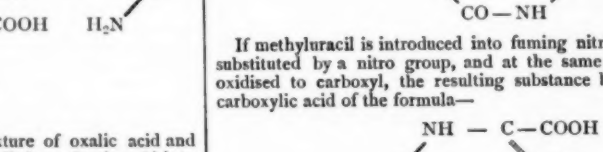
Behrend (*loc. cit.*) allowed a mixture of 10 grams urea, 20 grams acetoacetic ether, 40 c.c. alcohol, and 4 or 5 drops of hydrochloric acid, to stand for several days, and evaporated to complete dryness in a vacuum over sulphuric acid ; the residue was then washed with water and recrystallised from alcohol. The product so obtained was uramido-crotonic ether, formed according to the equation :—



This ethylic salt is very readily hydrolysed by soda, giving ethyl alcohol and sodium uramido-crotonate, $Na.C_5H_7N_2O_3$. The sodium salt is very easily soluble in water, and has a strong alkaline reaction ; by adding an acid, one does not obtain the corresponding uramido-crotonic acid, but methyluracil is precipitated ; this substance is even thrown down by carbon dioxide. It is an internal anhydride of uramido-crotonic acid, formed in the following manner :—

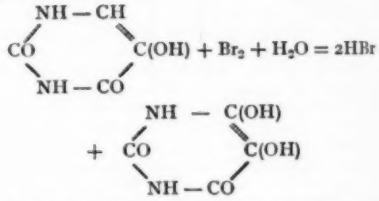


If methyluracil is introduced into fuming nitric acid, hydrogen is substituted by a nitro group, and at the same time the methyl is oxidised to carboxyl, the resulting substance being a nitrouracilcarboxylic acid of the formula—

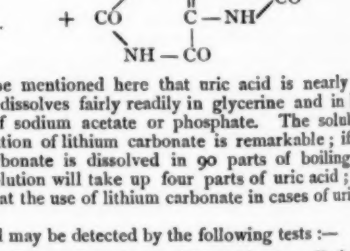


The potassium salt of this acid when heated to 130° loses carbon dioxide, and gives the potassium salt of nitro-uracil, $K.C_4H_2N_3O_4$, from which, by treatment with hydrochloric acid, nitro-uracil is obtained. By reduction of nitro-uracil or its potassium salt with tin and hydrochloric acid, amidouracil goes into solution, whilst some of the substance is converted into oxyuracil, $C_4H_4N_2O_3$, which is insoluble in acid solution. This can be purified by solution in potash, reprecipitation with hydrochloric acid, and recrystallisation from water.

Oxyuracil is oxidised by moist bromine to isodialuric acid (dioxyuracil)—



This isodialuric acid heated with urea and concentrated sulphuric acid furnishes uric acid, thus confirming the formula of Medicus (*Annalen*, 251. 235).



It may be mentioned here that uric acid is nearly insoluble in water, but dissolves fairly readily in glycerine and in hot aqueous solutions of sodium acetate or phosphate. The solubility of the acid in solution of lithium carbonate is remarkable ; if one part of lithium carbonate is dissolved in 90 parts of boiling water, the resulting solution will take up four parts of uric acid ; it is on this property that the use of lithium carbonate in cases of urinary calculi depends.

Uric acid may be detected by the following tests :—

(i.) Heated in a dry tube it yields without preliminary melting ammonia, prussic acid, urea, and cyanuric acid.

(ii.) It dissolves in oil of vitriol, but is reprecipitated in an unchanged condition when water is added.

(iii.) One of the most characteristic tests is that depending on the formation of murexide. The substance is treated with nitric acid, and evaporated to dryness on the water bath. A reddish residue is left, which changes to a purple colour on moistening with dilute ammonia.

(iv.) A small quantity is dissolved in a drop of caustic soda solution, and then brought in contact with a piece of filter paper, which

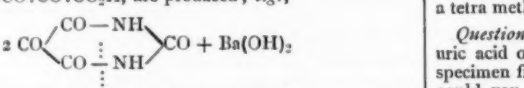
has been previously moistened with a drop of silver nitrate solution. Where the two solutions mix, a fleck of metallic silver is produced.

(v.) If uric acid is boiled with Fehling's solution, a precipitate of cuprous oxide is formed. (One molecule of uric acid reduces two molecules of cupric oxide.)

Some of the compounds obtainable from uric acid have now to be considered. It has already been mentioned that alloxan and parabanic acid successively result by oxidation; the preparation of the former of these two can be carried out in the following manner:—

One part of nitric acid (sp. gr. 1·42) is diluted with 8 to 10 parts of water of temperature 60°–70°, and into this warm dilute acid, uric acid is introduced; this must be done gradually, small quantities being added, as the previously introduced quantities of uric acid have dissolved in the dilute nitric acid. As soon as the solution is saturated with uric acid, it is heated to boiling. The solution is now treated with a concentrated solution of stannous chloride, to which an equal volume of hydrochloric acid has been added as long as alloxantin (a reduction product of alloxan of the formula $C_8H_6N_4O_8,2\,H_2O$) is precipitated. The alloxantin is then filtered off, washed with cold water, and dried on a porous plate. When dry the alloxantin is stirred up to a paste with a mixture of ordinary and fuming nitric acids, and left to oxidise back to alloxan until a specimen is completely and easily soluble in water. After drying the paste on porous tiles and heating in a porcelain dish on the water-bath until the remaining nitric acid has been expelled, the residue is recrystallised from the least possible quantity of boiling water (large colourless triclinic crystals).

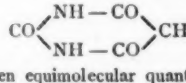
Alloxan, $C_4H_2N_2O_4$, crystallises with four molecules of water and yields metallic derivatives, such as $HgC_4N_2O_4,8\,H_2O$ and $Ag_2C_4N_2O_4$. If, however, alloxan be precipitated by stronger bases, such as lime-water or baryta-water, salts of alloxanic acid, $NH_2.CO.NH.CO.CO.CO_2H$, are produced; *e.g.*,



$$= (NH_2.CO.NH.CO.CO.CO_2)_2\,Ba.$$

The dotted line shows the point at which the closed ring gives way, with formation of an open-chain compound.

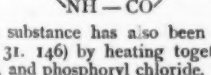
Alloxantin, $C_8H_4N_4O_7,3\,H_2O$ (or $C_8H_6N_4O_8,2\,H_2O$), is obtained from alloxan by reduction with stannous chloride; if alloxan be reduced, however, by zinc and hydrochloric acid, dialuric acid, or tartronylurea,



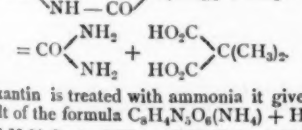
is produced. When equimolecular quantities of dialuric acid and alloxan are mixed, alloxantin is produced,

$$C_4H_2N_2O_4 + C_4H_4N_2O_4 = C_4H_6N_4O_8.$$

By heating aloxantin on the water-bath with three to four times its weight of oil of vitriol, sulphur dioxide is evolved; if when this gas ceases to come off the liquid be poured into cold water, a precipitate of barbituric acid or malonyl-urea,



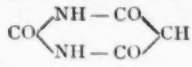
is obtained. This substance has also been obtained by Grimaux (*Bull. Soc. Chim.* 31. 146) by heating together equal weights of malonic acid, urea, and phosphoryl chloride. One of the hydrogen atoms of barbituric acid is easily replaceable by metals, though a di-silver salt, $Ag_2C_4H_2N_2O_3$, is known. It seems that the hydrogen atoms of the CH_2 group are the ones which are replaced, since the dimethyl derivative obtained by the action of methyl iodide on the silver salt can be split up into urea and dimethylmalonic acid.



When alloxantin is treated with ammonia it gives murexide, an ammonium salt of the formula $C_8H_4N_5O_6(NH_4) + H_2O$.

$$C_8H_4N_4O_7 + 2NH_3 = C_8H_8N_6O_6 + H_2O.$$

Liebig and Wöhler recommend the solution of four parts of alloxantin and seven parts of alloxan (containing four molecules of water of crystallisation) in 240 parts of hot water, and adding 80 parts of a cold saturated solution of ammonium carbonate. Murexide crystallises in four-sided prisms, having a beetle-green lustre, dissolving in water to a purple-red solution, and giving a blue liquid when dissolved in caustic potash. Another method of formation of murexide is to oxidise dialuramide,



with mercuric oxide.

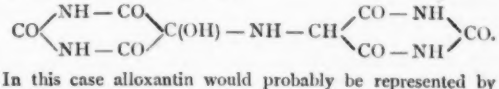
$$2C_4H_5N_3O_3 + HgO = C_8H_8N_6O_6 + H_2O + Hg.$$

The formation of murexide by evaporating uric acid with nitric acid and moistening the residue with ammonia has already been mentioned amongst the tests for uric acid.

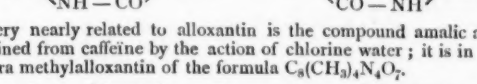
Murexide has been represented above as the ammonium salt of a compound which must have the formula $C_8H_5N_5O_6$; this is known as purpuric acid. It cannot be obtained in the free state, as when liberated from a purpurate (such as murexide) by an acid it decomposes into alloxan and dialuramide.

$$C_8H_5N_5O_6 + H_2O = C_4H_5N_3O_3 + C_4H_2N_2O_4.$$

Although purpuric acid is not known, many purpurates have been obtained. From its formation and mode of decomposition, it may have the constitutional formula,



In this case alloxantin would probably be represented by the formula,



Very nearly related to alloxantin is the compound amalic acid, obtained from caffeine by the action of chlorine water; it is in fact a tetra methylalloxantin of the formula $C_8(CH_3)_4N_4O_7$.

Questions—Advanced.—1. Give an account of the way in which uric acid occurs in nature, and state how you could obtain a pure specimen from any naturally occurring substance. 2. What means could you employ to determine the percentage of nitrogen in uric acid? 3. By what tests can uric acid be recognised? 4. Describe qualitative tests by which you could recognise acetonitrile (methyl cyanide).

Honours.—1. State the formulæ which have been proposed for uric acid, and discuss the evidence in favour of them. 2. How has Behrend been enabled to synthesise uric acid from acetoacetic ether? Name any other syntheses you know of which have been effected with this substance. 3. Describe the preparation of alloxan and alloxantin. How may barbituric and dialuric acids be obtained? 4. Explain the murexide test for uric acid, and discuss any formula which has been assigned to alloxantin.

MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,

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THE present and subsequent articles will be found to deal with such portions of mathematics as are included in the syllabus of the Science and Art Department for Mathematics, Stages 2 and 3.

We shall assume that the reader is in possession of one or other of the text-books mentioned below, as reference will be made to articles and examples which appear in these books. Other useful examples will be given, and solutions to such of them as are likely to present much difficulty.

The student is asked to provide himself with one or the other of the following text-books:—

STAGE 2.

Algebra.

Either Hamblin Smith's* or Hall and Knight's 'Elementary Work.'

Trigonometry.

Either Hamblin Smith's or Lock's 'Elementary Work.'

Euclid.

Any modern edition which contains Books II. and III.

* In future, H. S. will be used for Hamblin Smith, H. K. for Hall and Knight, and Tod. for Todhunter.

STAGE 3.

Algebra.

Either Todhunter's or Hall and Knight's larger work.

Plane Trigonometry.

Either Todhunter's larger work or Loney's Part I. Hamblin Smith's or Lock's 'Elementary' may suffice, although the treatment is scarcely full enough.

Euclid.

Todhunter's 'Euclid,' but Nixon's 'Euclid Revised' will be found more serviceable.

STAGE 2.

Algebra.

Read—Chap. III., H.S., or Chap. XV., H.K.

Work—H.S., Exs. X., Nos. 4, 8, 12, 20, 25, 28, 29; or H.K., Exs. XV.*a*, Nos. 7, 14, 20, 26, 30, 35; Exs. XV.*b*, Nos. 3, 11, 16, 26; Exs. XV.*c*, 3, 6, 13.

1. If $(3x^2-2x-1)^2 = 9x^4 - ax^3 - 2x^2 + bx + 1$, find the value of a and b. Ans. 12 and 4.

2. If $(2x^2 + y^2 - 3z^2)^2 = 4x^4 + 4x^2y^2 + ax^2z^2 + y^4 - by^2z^2 + 9z^4$, then $a + 2b = 0$.

Read—H. S., Chap. XVII., or H. K., Chap. XVI.

Work—H. S., Exs. LXXIX., Nos. 3, 5, 10; Exs. LXXX., Nos. 2, 7, 13, 22, 26; or H. K., Exs. XVI.*a*, Nos. 4, 13, 20; Exs. XVI., Nos. 6, 10, 20.

3. Find the square root of
$$(a-b)^4 - 2(a^2+b^2)(a-b)^2 + 2(a^4+b^4).$$
Ans. a^2+b^2.

4. Find the square root of
$$x^6\{4(1+x)(2+x)(2-x) + x^4\}.$$
Ans. $4x^3 + 2x^4 - x^5$.

Trigonometry.

Read—H. S., Chaps. II. and III., or Lock, Chaps. III. and IV., omitting Arts. 30, 31, 32, 33, and 37.

A few remarks concerning the essential portions of these chapters may be useful. The first fact to be learnt is that for any circle, *the ratio of the circumference to the diameter is constant, the* exact *value of which is denoted by* π, *an approximate value of which is* $\frac{22}{7}$, *or better still,* 3·14159. Thus we have the relation

$$\text{Circumference} = \pi d = 2\pi r,$$

where d is the diameter and r the radius.

In considering the three systems of measuring an angle, the student must be able to define the three units, viz. the *degree*, the *grade*, and the *radian*, as well as to *realise* their relative magnitudes. Thus, while the difference between a degree and a grade is comparatively small, the radian is, roughly speaking, about 60 times as large as either of these units. The exact meaning of the *circular measure* of an angle must be clearly understood. If these matters are clear, then the conversion of an angle from one system to another should present no difficulty.

An angle denoted by 3° contains a *degree* 3 times, but an angle denoted by 3^c or simply 3 contains a *radian* 3 times, and therefore contains

$$3 \times \frac{180}{\pi} \text{ degrees.}$$

Again, when π refers to a number it means $\frac{22}{7}$ (or 3·14159), but if it refers to an angle, then the angle contains π radians and is therefore 180°. The student will do well to become familiar with the following results :—

The circular measure of 180° is π,

" " " " 90° is $\frac{\pi}{2}$,

" " " " 60° is $\frac{\pi}{3}$,

and so on.

Work—Exs. III., H. S., Nos. 2, 3, 8, 11, or Lock, Exs. V., 3, 5, 8, 11. Also select and work out three examples from each of the sets IV. to XI. inclusive in H. S., or from Lock, Exs. VII., Nos. 1, 9, 12, 17; Exs. VIII., Nos. 1, 3, 10; Exs. IX., two parts of each of the examples 1 to 4.

Also the following :—

1. Define the unit of circular measure, and determine in degrees the angles whose circular measures are 1·5 and $\sqrt{5}$ respectively. Convert to circular measure the angles 60° and 200°.
Ans. $85\frac{10}{11}°$, 128·06°, $\frac{\pi}{3}$, $\frac{10\pi}{9}$.

2. AB is the diameter of a circle, and C a point in the circumference; the arc BC measures 11 feet, and subtends an angle of 15° 45′ at A; find the radius of the circle and the length of the arc AC. Ans. 20 ft., $51\frac{4}{7}$ ft.

3. Define the circular measure of an angle, and find from your definition the circular measure of a right angle. Express the angle 44° as a fraction of the angle whose circular measure is 1·5. Ans. $\frac{44}{135}$.

4. The circular measure of two angles of a triangle are respectively $\frac{1}{3}$ and $\frac{1}{4}$; what is the number of degrees in the third angle? Ans. 132° 15′ 12·6″.

5. Find in radians, degrees, and grades, the angle between the hour hand and the minute hand of a clock at twenty minutes to six.
Ans. $\frac{7\pi}{18}$, 70° $77\frac{7}{9}$′.

Euclid.

Read the first seven propositions in Book II.

Work the following riders :—

1. If a straight line be divided into two equal, and also into two unequal, parts, the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.

2. In the straight line ABCD the segments AB, CD are equal. Prove that the squares on AD, BC are double of the squares on AB, BD.

3. Prove that the rectangle contained by the diagonals of the squares on the whole line and on one of the parts is equal to twice the rectangle contained by the whole line and that part.

4. Divide a given straight line into two parts such that the rectangle contained by them shall be the greatest possible.

STAGE 3.

Algebra.

The first portion of the subject we have to deal with is that of *Permutations* and *Combinations.**

Read Arts. 487, 488, 489 in Tod., or Art. 139 H.K.

After considering the definitions of the two terms, it is necessary to observe the truth of a most important principle given in H.K. Art. 140, and which is here quoted :—

If one operation can be performed in m *ways, and (when it has been performed in any one of these ways) a second operation can be performed in* n *ways; the number of ways of performing the two operations will be* m × n *ways.*

As an illustration of this let us consider the following example :—

On two different days a man has to drive to a railway station, and he can choose from 4 different vehicles; in how many ways can he make the journeys, the same vehicle not being used for both journeys?

The first journey can clearly be made in 4 different ways; when it has been made in any one way there are 3 ways only of making the second journey, since the same vehicle must not be used for both journeys.

The above principle tells us that the number of ways of performing the two journeys is 4 × 3. And the truth of this is evident; for, if we denote the vehicles by A, B, C, D, and suppose A to be used on the first journey, then B, C, or D may be used on the second journey, thus giving *three* ways of making the two journeys by using A each time for the first journey. Similarly there would be three different ways by using B on the first journey; similarly for C and D; hence the required number is 4 × 3, or 12.

Read Tod., Arts. 490 to 498 inclusive, or H.K., Arts. 140 to 151 inclusive.

No progress will be made until the formulæ established in these articles are learnt. We refer to the following :—

$${}_nP_r = n.(n-1)(n-2).....(n-r+1).$$

$${}_nP_n = \lfloor n.$$

$${}_nC_r = \frac{n.(n-1)(n-2).....(n-r+1)}{\lfloor r}, \text{ or } \frac{\lfloor n}{\lfloor r \lfloor n-r}.$$

Example.—From 10 men 6 have to be selected. In how many ways can this be done? In how many of these will the same 4 men be chosen?

This is a case of combinations, hence the first answer is

$${}_{10}C_6 = \frac{\lfloor 10}{\lfloor 6 \lfloor 4} = 210.$$

* ${}_nP_r$ stands for number of permutations of n things r at a time, and similarly ${}_nC_r$ for combinations.

Again, if 4 particular men have always to be chosen, we may consider the remaining 6, and from them choose as many two's as possible. This gives

$$_6C_2 = \frac{\lfloor 6}{\lfloor 2 \,\lfloor 4} = 15.$$

Hence, since each of these 15 couples may be associated with the 4 particular men, there must be 15 ways of selecting 6 from 10 so as always to include a particular 4.

[N.B.—It would obviously be wrong to reduce the 10 men to 7 by supposing the particular 4 men to be one man, and then to find groups of 3 from 7.]

Example.—In how many ways can ten examination papers be arranged so that the best and worst never come together?

We may first find the number of ways, ignoring the restriction; this would be $\lfloor 10$. The number of ways in which the two particular papers may come together may be found by supposing them to become one, thus giving 9 papers. By arranging these in all possible ways we see that the two papers may merely come *together* in $\lfloor 9$ ways; but, remembering that the best may come either before or after the worst, we get $2\lfloor 9$ ways in which they come together. Hence $\lfloor 10 - 2\lfloor 9$ must be the number of ways in which they never come together.

Work—Tod., Exs. XXXIV., Nos. 5, 9, 8, 14, 22, 25, 26, or H.K., Exs. XL.*a*, Nos. 2, 5, 6, 11, 13, 18, 25, 27.

Also the following:—

1. If 15 constables out of 25 are on duty every night, in how many ways can they be selected? And, if all have the same number of turns, on how many nights out of 100 will each constable be on duty? Ans. 3,268,760; 60.

2. Each of two bags contains 12 different coins; find how many different combinations of 10 coins can be made by taking 5 out of each bag. Ans. $\left\{\frac{\lfloor 12}{\lfloor 7 \,\lfloor 5}\right\}^2$.

3. Show that the number of permutations, each of 3 letters, which can be formed from two like complete alphabets is 25, 26, 27.

4. From 3 cocoa-nuts, 4 apples, and 2 oranges, how many selections of fruits can be made, taking at least one of each kind? Ans. 315.

5. How many numbers less than 10,000 can be made with the eight digits, 1, 2, 3, 0, 4, 5, 6, 7:—(1) When no digit is used more than once in the same number; (2) when any digit may be used 1, 2, 3, or 4 times in the same number?

6. There are n different books, and p copies of each; find the number of ways in which a selection can be made from them. Ans. $(p+1)^n - 1$.

Trigonometry.

For this stage a fuller and more thorough knowledge is required of the fundamental formulæ for sin, cos, and tan of (A + B), (A − B), and formulæ which may be immediately derived from them. For example, the student must be able to prove that they are universally true. That is to say, he must read carefully Chap. VI. in 'Todhunter,' or Chap. VII. in 'Loney.' In Tod., Art. 326, it is shown how these formulæ may be deduced the one from the other. *See also* 'Loney,' Art. 93, Ex. 2.

The geometrical proof of tan (A + B) is not given in Tod. (*see*, however, Art. 325), but will be found in 'Loney,' Art. 99. Neither are the geometrical proofs of sin 2A, cos 2A, tan 2A, given in Tod., but they will be found in 'Lock,' Art. 163, or in 'Loney,' Art. 106.

The formulæ for the sum and difference of two sines or two cosines are also proved geometrically in 'Lock,' Art. 160, and in 'Loney,' Art. 95.

The above remarks will serve to indicate some of the portions of the text work which require the attention of the student, and as they are fully dealt with in the text book, they require no explanations here. We shall now append some examples bearing on the above formulæ, solutions to some of which will be given next month.

1. If $\sin\alpha = \frac{12}{17}$ and $\cos\beta = \frac{12}{13}$, find the value of $\tan(\alpha+\beta)$. Ans. $\frac{220}{21}$.

Prove the following:—

2. $\dfrac{\sin(A-B)}{\cos A \cdot \cos B} + \dfrac{\sin(B-C)}{\cos B \cdot \cos C} + \dfrac{\sin(C-A)}{\cos C \cdot \cos A} = 0.$

3. $\cos^2(A-B) + \cos^2 B - 2\cos(A-B)\cos A \cdot \cos B = \sin^2 A.$

4. $\cos 3A + \cos 5A + \cos 7A + \cos 15A = 4\cos 4A \cdot \cos 5A \cdot \cos 6A.$

5. $\sin 10° + \sin 20° + \sin 40° + \sin 50° = \sin 70° + \sin 80°.$

6. $2\cos\frac{\pi}{13} \cdot \cos\frac{9\pi}{13} + \cos\frac{3\pi}{13} + \cos\frac{5\pi}{13} = 0.$

Euclid.

Work the following:—

1. Let O and C be any fixed points on the circumference of a circle, and OA any chord; then if AC be joined and produced to B, so that OB is equal to OA, the locus of B is an equal circle.

2. Two circles cut one another at a point A; it is required to draw through A a straight line so that the extreme length of it, intercepted by the two circles, may be equal to that of a given straight line.

3. C is the centre of a circle, and CP is a perpendicular on a chord APB; show that the sum of CP and AP is greatest when CP is equal to AP.

4. Draw a parallelogram ABCD, and the diagonal AC; take a point O outside the parallelogram, but within the angle DAC; join OA, OB, OC, OD; show that the triangle AOC equals the difference between the triangles AOB and AOD.

5. Find the locus of a point from which equal tangents can be drawn to two given circles.

What is the position of the locus when the circles are very nearly concentric?

MAGNETISM AND ELECTRICITY.

BY EDWIN EDSER, A.R.C.S.

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In last month's number the relations between the intensity of magnetization of iron and the magnetizing force to which it is

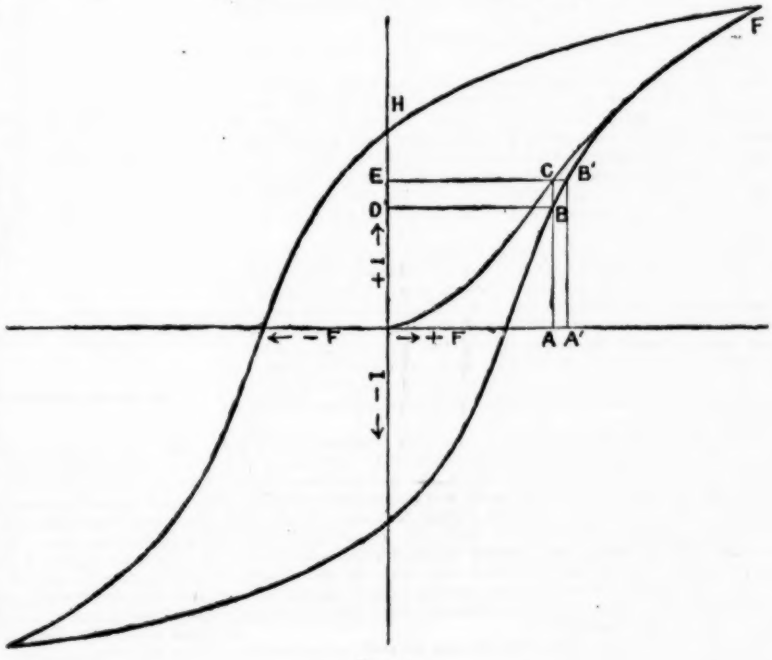

FIG. 1.

subjected were discussed, and the results shewn in a diagrammatic form. It is intended in the present number to indicate an important property of this Hysteresis diagram, as it is called.

When a bar of magnetizable material is subjected to a complete cycle of magnetization (*i.e.* when, starting with an unmagnetized bar, a magnetic force is applied which increases up to a certain point, then decreases till it passes through zero, and, becoming negative, reaches an arithmetical value equal to the greatest positive value, finally increasing till the value zero is again reached), the Hysteresis diagram is such as is shewn in fig. 1. The part of this diagram lying in the upper right-hand quadrant has been already discussed, and the student should find no difficulty in interpreting the part situated in the lower left-hand quadrant. It will now be shown that the area enclosed by this diagram is proportional to the work done during the cyclical process.

The following reasoning may help the student to a clearer comprehension of the meaning of the terms used above. It is required to determine a formula for the work done in taking a bar of iron or other magnetizable material through a cycle of magnetization.

Suppose that we start with a magnetizing force F, say, which produces an Intensity of Magnetization I, and that as F increases to $F + f$, I increases to $I + i$, f and i being small in comparison with F and I; then if two parallel planes, each of 1 sq. cm. area, be taken perpendicular to the axis of the magnet, at a very small distance l apart, the inclosed magnetized matter will be equivalent in its action to a magnetic shell of strength Il and $(I + i)l$ at the beginning and end of the experiment respectively. Since the magnetizing force = F at the beginning, and $(F + f)$ at the end, of the experiment, the average value will be $F + \frac{f}{2}$. What we have done, therefore, is equivalent to superimposing a magnetic shell of strength il on one of strength Il; and the problem therefore resolves itself into determining the work done in bringing a shell of strength il up from infinity to a point where the force $= F + \frac{f}{2}$.

It is shewn in S. P. Thompson's *Elementary Lessons in Electricity and Magnetism*, §§ 315, 316, that the work done in bringing a magnetic shell of strength S up to a point where there are N lines of force per sq. cm. (*i.e.* where the magnitude of the force = N) = Ns. Substituting for N, $F + \frac{f}{2}$, and for s, il, we get

Work done in bringing up magnetic shell of strength il

$$= il\left(F + \frac{f}{2}\right) = Fil + \frac{ilf}{2}.$$

In this formula, the term $\frac{ilf}{2}$ will be small in comparison with Fil, since f is small in comparison with F; therefore the work required = Fil.

Now to find the work done in magnetizing the whole magnet, we can consider it made up of a number n of magnetic shells, each bounded by two planes at a distance l apart. If the area of each of these = a, then the work done in magnetizing each will be $Fila$, and that in magnetizing the whole of the magnet = $Finla$ = $FiLa$ = FiV, if nl = L = length of magnet, and V = volume of magnet.

If we now call the new value of F, F_1, and the new value of I, I_1, we shall get, on increasing F_1 to $F_1 + f_1$, and I_1 to $I_1 + i_1$, work done = $F_1 i_1 V$.

To get the whole work in passing through a complete cycle, we must therefore proceed as follows:—Starting with any force and the corresponding intensity of magnetization, increase the force by a small amount, and multiply the *increase* of the intensity by the *value* of the force, then proceed through the same operation again, thus passing round the entire cycle; the sum of the products multiplied by V, the volume of the magnet, will give the value of the work absorbed; in the operation the unit of work being, of course, the erg, if the C.G.S. system be used in the measurement of F and I.

Now turn to the diagram, fig. 1. Let OA represent the first value of F, AB being the corresponding value of I. Let $AA_1 = f$, and therefore $A^1B^1 = AC = I + i$. Then $BC = i$, and Fi = OA × BC = area BCED. Proceeding in the way before indicated along the lower curve as far as F, and then adding the value of the areas of all these rectangles together, we shall get a result equal to the area BFGDB, less the area of a number of triangles similar to BCB^1. Also, when the increase of force AA^1 is very small, the area of each of these triangles will be very small, and can be neglected in comparison with that of the rectangles; therefore work done in passing from B to F = area BFGDB.

On now decreasing the force step by step we shall pass along the upper curve; and work done will be equal to area FGHF, *taken with a negative sign*, since the intensity is decreasing, and therefore the quantities such as i will be negative. On adding these two together we see that the negative area FGHF cancels the same part of the positive area, and consequently work done in passing from B through F to H = area BFHB.

Proceeding in this way right round the diagram, we get finally that the work done per unit volume in passing through the cyclical operation denoted by the figure, equals the area contained by the curve.

The energy thus absorbed is of course not annihilated, but makes its appearance as heat, thus raising the temperature of the iron specimen experimented upon. By determining the amount of heating, we can therefore find the energy dissipated by Hysteresis, which gives us a means by which we can check results found by the former method.

The practical importance of the information thus conveyed to us will be at once apparent on considering the action of iron in the cores of alternate current transformers. A transformer is really in its principle of action the reverse of an ordinary Ruhmkorf coil; in the latter we send a considerable current, of a low potential, which fluctuates in value very quickly, through a few turns of wire wound round an iron core, and produce a fluctuating current, of small amount but high potential, in a coil of many turns wound outside the former. In either case, if C_1V_1 and C_2V_2 represent the current and potential in the primary and secondary respectively, if there be no loss from heating the coils or in Hysteresis, or the production of Foucault currents, we shall have, by the principle of the conservation of energy,

$$C_1V_1 = C_2V_2.$$

If, however, energy be absorbed in Hysteresis, less energy can be taken out of the coil or transformer than is put in; the consequence being a loss that may be considerable.

On comparing the curve showing the magnetic properties of soft iron with that showing the same properties of steel, it will easily be realised why the latter metal would be a bad substance to use in making cores for transformers or induction coils.

One way, then, of determining the loss of energy due to Hysteresis is to obtain the curves showing the relation of I to F by one of the methods previously described, plot the results, and then measure the area with a planimeter or otherwise. Professor Ewing has, however, devised a simple instrument which will quickly determine the *relative* loss of energy in different specimens of iron. A side elevation of the instrument is diagrammatically represented in fig. 2.

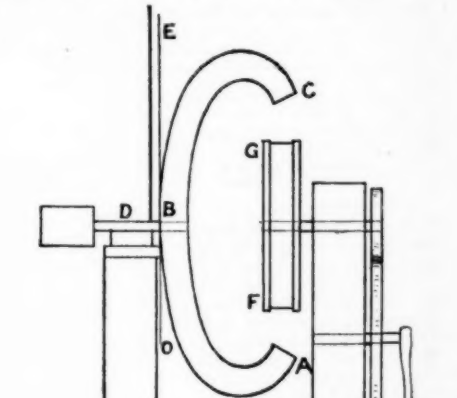

FIG. 2.

ABC is a permanent magnet, which is balanced on a knife-edge at D, and is provided with a pointer BE which moves over a scale. The samples of iron to be tested are punched from a sheet, and clamped between two ebonite washers, the whole FG being fastened on to a spindle which can be quickly revolved by means of a handle and multiplying gear. If the samples be slowly revolved the permanent magnet gives a series of kicks at each half revolution; but on increasing the speed the pointer indicates a permanent deflection which is proportional to the energy lost due to Hysteresis, and is independent of the speed for all but very high rates of revolution, when alone the effect of Foucault currents becomes noticeable. From what has previously been said, something of the value of this instrument to the electrical engineer can be easily imagined.

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SCIENCE NOTES.

THE BRITISH ASSOCIATION.—The annual gathering of the representatives of English science has been held this year in East Anglia, Ipswich being the favoured town. The meeting was much smaller than usual, due no doubt to the circumstance that Ipswich was sandwiched between Oxford and Liverpool, both of which are large and important scientific centres. The diminution in the numerical membership did not, however, affect the sections unequally, each being fairly attended by the leaders in the respective sciences. Perhaps the most interesting feature of the meeting was the final disruption of the old section D, which used to represent Biology. At Oxford the Physiologists seceded and founded section I, and at Ipswich the final division of the remainder into Zoology, which retains the old designation D, and Botany, now labelled section K, has taken place. Strange to say, the division, instead of temporarily weakening any section, has at once strengthened all, and a good prospect of useful work is before all three of the new fractions. Representatives from the Continent and from America have visited the Association, though not so many as on some other occasions, especially the meetings at Manchester, Edinburgh, and Oxford. Among them may be mentioned Professor Bedell (Physics), Professor Remsen and Professor Runge (Chemistry), Dr. Hansen, Graf zu Solms Laubach, and Dr. Treub (Botany).

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SCIENCE AND ITS RELATIONSHIPS.—The Association at this meeting seemed in a condition of unrest, and in more than one place was occupied with efforts to prove that the sciences which it fosters have a special technical bearing which has not yet been fully realised. The section devoted to Mechanics had this impressed upon the members early in the meeting by its president, Mr. L. F. Vernon Harcourt, who devoted his address to a demonstration of the relations between science and engineering, and a criticism of the bearing of Mathematics, Physics, Chemistry, Geology, and Meteorology upon the practical subject.

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SCIENCE AND AGRICULTURE.—A similar propaganda found its way from section B, where the chemists laid before themselves the duty of demonstrating that the agricultural problem would only be adequately solved by the recognition of the need of scientific methods of farming, and of the utilization of the latest discoveries of scientific investigation. This subject seemed peculiarly appropriate to an East Anglian meeting, agriculture being the staple industry of that part of the country. The contribution took the form of a discussion held jointly by the chemists and the botanists under the presidency of Professor Meldola. The matter was introduced in an able address by Professor Warrington, of Oxford. The Director of Kew Gardens was the first speaker from the side of the botanists. The discussion was warmly supported both by representatives of agriculture, who attacked the matter from its practical side, and by the theorists and the exponents of pure science. Among the speakers may be named Lord Walsingham, Sir John Evans, Sir Hy. Roscoe, Professors Liveing, Marshall Ward, and Reynolds Green.

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THE OYSTER SCARE.—Not agriculture only, but other avocations find a home in East Anglia, and especially among the latter may be noted the culture of oysters. Especially interesting, therefore, was a paper read in the Zoological section by Professor Herdman and Professor Boyce, giving an account of some experiments carried out by them jointly at Liverpool during the past year upon the effect of sewage contamination upon the health and well-being of the oyster. The work was partly done at Port Erin, in the Isle of Man, where there is a well-appointed marine laboratory, and partly at the laboratories at University College, Liverpool. The investigators found that the oyster is not prejudicially affected by a small amount of sewage, indeed it can make use of its constituents. Even typhoid microbes had to be in considerable quantity in the salt water to be harmful. Stagnant water was soon rendered uninhabitable on account of the microbic demands upon the oxygen, but if the latter gas were injected into the water, much of the harmful influence was done away with. The point of view of the workers was of course that of the well-being of the bivalve; the larger question of the possibility of transmitting typhoid contagion by means of the oyster was not more than inferentially considered.

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THE NEW ELEMENTS.—It will be in the recollection of all that it was at the Oxford Meeting twelve months ago, that the chemical and physical world was agitated by the announcement of the discovery of argon. Some little while later, *helium*, known to be present in the sun, was extracted from certain rare minerals. Naturally curiosity in the frequenters of the chemical section turned to these two bodies, hoping to hear that more had been discovered about them. From certain difficulties in putting them in due sequence with the other elements in the tables constructed by Mendeleef, it was thought they might not be elements at all, but rather mixtures of elements. Whatever be the case with argon, helium seems to come under the latter category. Professor Runge has subjected the gas, in small quantities certainly, to prolonged examination by the spectroscope, and is led to the conclusion named. Further, when it is made to diffuse slowly through a porous plate or plug, the density of the emergent gas is found to have changed, supporting the idea that it is a mixture of two gases of different densities and of unequal powers of diffusion. Mr. Crookes is now working further at its spectroscopic features.

***

ADVANCE IN GEOGRAPHICAL SCIENCE.—The section devoted to Geography was the scene of considerable excitement on more than one occasion. Nothing seems to stir the average Briton so much as exploration of either Arctic or Antarctic regions, and both of these were well put forward during the meeting. Captain Borchgrevink occupied a good part of one day's session by a description of his discoveries in the Antarctic seas, and indicated certain lines on which South Polar discovery might proceed. He outlined an expedition that he suggested should start for the South Pole next spring. The vessel should be a small one of two hundred tons, and should be furnished with a crew composed mainly of Englishmen. There should be on board a meteorologist, a mineralogist, engineers, a doctor, and a chemist. The expedition should be furnished with Esquimaux dogs and sledges, and with a captive balloon for observations. Captain Borchgrevink professed himself willing to lead such an expedition if it could be organised.

The recent news of the Jackson-Harmsworth Arctic expedition arrived in time to form the subject of much comment and discussion.

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GREATER BRITAIN.—The selection of a meeting place for 1897 took place on Monday, Sept. 16, when the general committee found themselves most cordially invited to visit Canada again. Pleasurable recollections of the meeting at Montreal in 1884 were in the minds of many, and when the President announced that Toronto was most anxious to be visited in turn, the response in the affirmative was eager and cordial. Sir Charles Tupper addressed the committee at some length, pressing the advantages afforded both to the Association and to the Dominion of Canada by the proposed visit. The Mayor of Toronto, who hoped to have been present at the Ipswich meeting, but was prevented by illness, telegraphed a hearty endorsement of the invitation, which was unanimously accepted. There is a great probability that the American Association will join the British one on this occasion, so that the meeting at Toronto will be a joint one.

REVIEWS.

University Correspondence College Intermediate Arts Guide No. X., and Intermediate Science Guide No. VII. London: Clive & Co.

The would-be entrant into the sacred portals of London University owes a debt of gratitude to the editors and publishers of the above guides. Free gratis and for nothing, the neophyte is furnished with a *vade mecum* whose fulness is only surpassed by its clearness. Of course the issuers hope that the student, seeing herefrom the excellence of the organisation and the large amount of success achieved thereby, may at once join the U.C.C. army of students. And to this we feel constrained to say that if the student does join, his sagacity will be thereby evidenced. The guides are simply excellent.

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the heterogeneous collection of ill-connected and ill-digested facts so often to be found in the so-called science readers. Here we get pabulum suitable for the digestion of a 1st class, or of the ordinary man in the street who wants knowledge and not a variety entertainment. When we say that, *inter alia*, the authors treat of the Darwinian Theory, Evolution and Development in Chemistry, Nebular Theory and Tidal Evolution, Molecules and Molecular Force, Bacteria, it will be seen that the scope of the book is unusual. The treatment of such a syllabus as the one pointed out must needs be skilled, failure being much more imminent in a book of this somewhat ambitious character. We have carefully gone through the various sections, and have been gratified by the unvarying excellence of the work, which we cordially recommend as likely to advance the cause of science amongst the people if they can only be got to read it. A few more illustrations would not be out of place.

Sheila's Mystery. By Mrs. Molesworth. London: Macmillan & Co.

This story is of a somewhat romantic kind, with childish jealousy, gypsy wanderings, and a puzzling secret for its elements of interest. The mystery is well maintained, and the moral inculcated is wholesome, if the framework of incident and relationship seems rather far-fetched. We could hardly recommend the story for the youngest children who might be able to read it, but elder school-girls would probably appreciate it; and for such it would be a very suitable prize-book. The style is easy and pleasant as might be expected from so experienced a writer as Mrs. Molesworth; but the expression, 'Mr. Josselin was late of returning,' strikes one as rather awkward. The volume is well-printed and illustrated, and presents an attractive appearance.

Alice Sherwin. A Tale of the Days of Henry VIII. By C. M. J. London: Burns & Oates, Limited.

So far as 'Alice Sherwin' is in form and substance a work of fiction, it is an historical novel of the old-fashioned sort, reminding the reader in some measure of the works of G. P. R. James and Harrison Ainsworth. When one has got over the preliminary chapters, one becomes really interested in the fortunes of Alice and her relations. The narrative, however, is rather overweighted with the mass of historical detail which occupies a large part of the volume. Many chapters have but a very slight connection, if any at all, with the story of Alice. They set forth rather the incidents connected with the divorce of Catherine, the fall and death of Wolsey, the trials and execution of Sir Thomas More and Bishop Fisher, and the dissolution of the monasteries. As the book belongs to a Catholic Series, all these events are of course treated from the Catholic point of view. The nature of the events thus dealt with makes the book hardly suitable for school children, so we cannot recommend it for the school library or for a scholar's prize-book. But to those teachers and other elder readers who wish to see how the history of the second Tudor King appears to the supporters of the Papal claims, the book is likely to be both interesting and instructive.

Word-Building, Transcription and Composition. By R. S. Wood. Part I., Standard I. London: Macmillan & Co.

This is the first of a series of books to provide simple exercises as aids to correct spelling. The scheme laid down is based on rational principles, and appears likely to produce excellent results in cultivating the observation and intelligence of the children. On Mr. Wood's plan a lesson presents a set of five exercises: A, A list of words arranged according to sound; B, Transcription of sentences which contain the words in A; C, Elliptical sentences in which missing words have to be supplied from the previous list; D, Groups of words to be bound and fitted together to make sentences; E, Lists of words built up from those in A, to be transcribed and learnt. The book is well-printed and cheap, and should accordingly be largely used.

The Wanderings of Ulysses, selected from the Odyssey. Edited by E. D. Stone, M.A. London: Methuen & Co.

Of the nineteen passages in this little work, all but one are selected from the first twelve books of the Odyssey, and the remaining one from the thirteenth. The introduction contains observations on some of the problems connected with the Homeric epics, and is accompanied by several pictorial illustrations copied from Greek vases. The selections are very clearly printed, and the notes, which are partly explanatory and partly philological, are brief and yet helpful. The work appears likely to realise its aim of proving a useful introduction to the study of Homer.

Hand and Eye Training. By George Ricks, B.Sc. (Lond.), and Joseph Vaughan. I., Designing with Coloured Papers; II., Modelling in Cardboard. London: Cassell & Co., Limited.

These two volumes are the first issued of a revised, enlarged, and re-arranged edition of the well-known series of books on Hand and Eye Training by Mr. Ricks. The treatment of each subject in a separate volume has considerable advantages, and in the new form the instructions seem to be clearer, and the graduation more thorough and systematic.

The use of coloured papers in designing may undoubtedly be made to have a very decided effect upon the skill and artistic taste of young pupils, and we have knowledge of the remarkable results produced in this direction where Mr. Ricks's method has been adopted by zealous and careful teachers.

In the Modelling in Cardboard especially, it might well be doubted, as the authors say, whether young children could manage to construct such complicated figures as are shown in the text-book; but the proof that they can must be quite convincing to those who have seen children in school actually doing the work which is shown at the various exhibitions held under the auspices of the London School Board.

The work is produced by the publishers in admirable style, and the shaded plates are really excellent.

Franz Thimm's French Self-Taught. Thimm's German Self-Taught. Thimm's Italian Self-Taught. Thimm's Spanish Self-Taught. Thimm's Norwegian Self-Taught. London: E. Marlborough & Co.

These books make no pretence to teach the Continental languages as branches of literary study. Their aim is of a humbler kind, but it is at the same time a very practical one. They are intended to help the many travellers, tourists, and others who wish to be able when in a foreign country to make themselves understood and to understand the words of the natives with whom they meet. For this practical purpose the system of these books seems thoroughly well-adapted. Each contains some simple general instructions on pronunciation, followed by a vocabulary extending over several pages including the most commonly used English words with their foreign equivalents, and the pronunciation of the foreign words indicated on a simple phonetic method. A brief outline of the Grammar of the language is also given, and then follows a large assortment of sentences used in every-day conversation. The sentences, like the words in the vocabulary, are classified according to subject, and the pronunciation is invariably indicated.

Anyone who fairly masters the contents of one of these handy manuals should not find himself altogether at a loss for means of conversing with the people whose language the book is designed, within certain limits, to teach.

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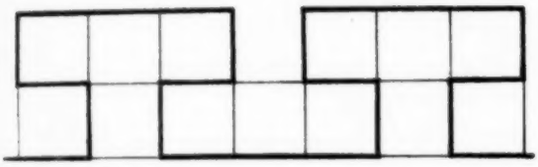

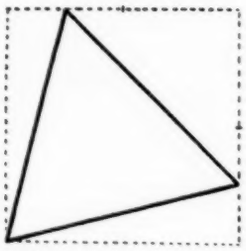

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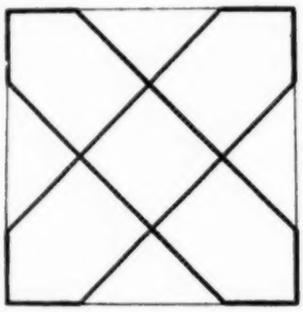

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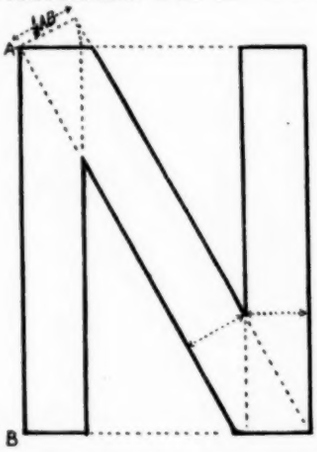

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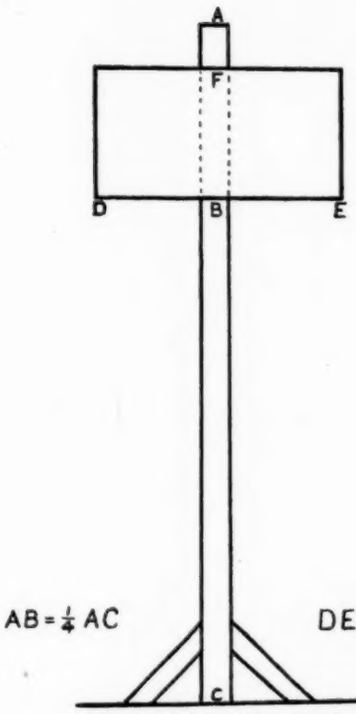

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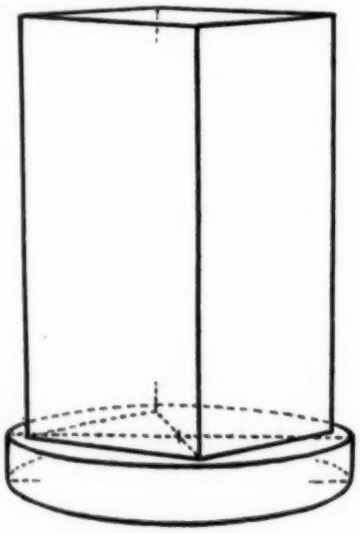
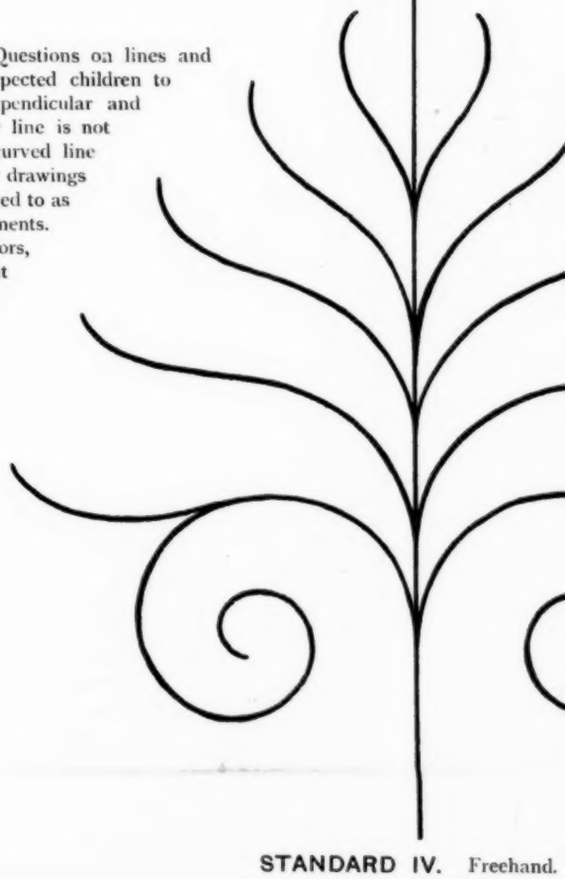


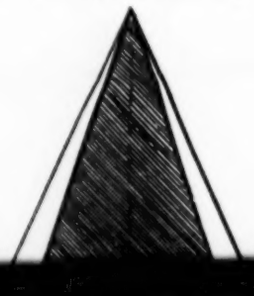
STANDARD V. Model.

STANDARD V. Geometry. (1) Describe a circle of one inch radius, and divide the circumference into four equal parts. (2) Copy a (vertical) line A B, and on it construct an equilateral triangle. (3) Make a triangle on a base of 2½ inches, and the angle at the apex 90°.

STANDARDS I. & II. Questions on lines and angles were asked. Inspector expected children to know the difference between perpendicular and vertical, and that a perpendicular line is not necessarily upright. Large easy curved line drawings had to be shown, but any drawings showing complex curves were objected to as being beyond the Standard requirements. Some fair attempts at drawing doors, windows, etc., were also shown, but less was expected than the children had accomplished.



STANDARD IV. Freehand.

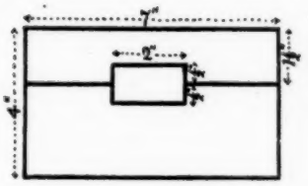


STANDARD V. Model.

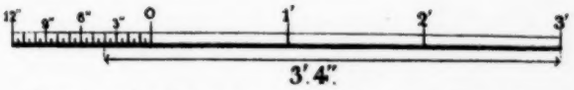
STANDARD V. Geometry. (1) Describe a circle

ING EXAMINATION.

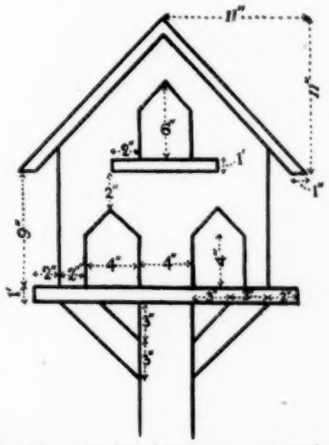
III. Freehand.



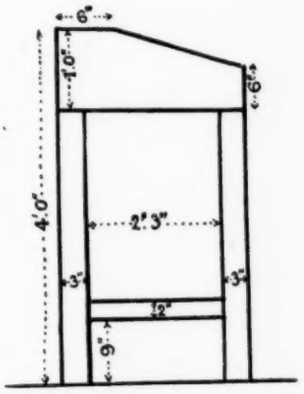
To be drawn on squared paper. The side of each square represents a quarter of an inch.



Draw a scale of 1″ to 1′ and mark on it a length of 3′ 4″.

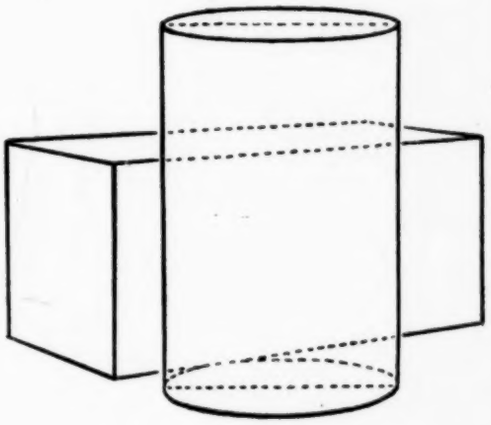


STANDARD IV. To be drawn on squared paper. The side of each square represents one inch.



STANDARD IV. To be drawn on plain paper to a scale of 1″ to 1′.

ALL STANDARDS. Drawing books had to be shown. The course of lessons, as shown by the books, was criticised. A course from a chart was condemned as not being a progressive one, but might, the inspector said, have been made so had the teacher changed the order somewhat. A book showing great progress on the part of the child who had filled it, was much more commended than one showing uniform work throughout.



STANDARD VII. (1) Draw a scale of 1½ inches to a foot, and draw a line 3′ 10″ long according to scale.

A ⊙ ⊙ C ⊙ B (2) Copy the points A B C, and describe a circle to pass through them.

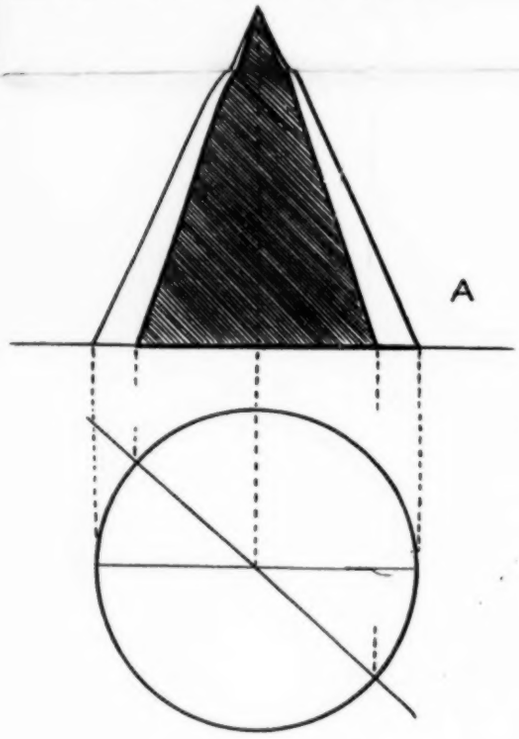
(3) The side of a hexagon is 1 foot 2 inches long. Draw the hexagon. (Scale 1½ in. to a foot.)

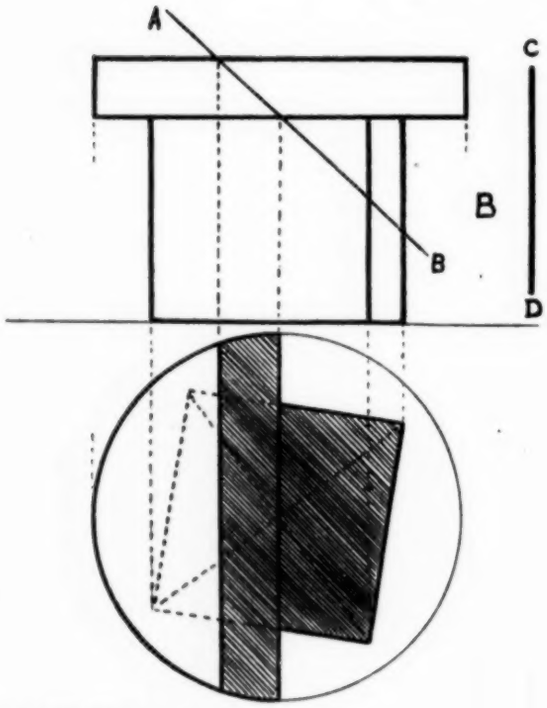
V. Freehand.

A ⊙ ⊙ C ⊙ B (2) Copy the points A B C, and describe a circle to pass through them.

STANDARD V. Model.

STANDARD V. Geometry. (1) Describe a circle of one inch radius, and divide the circumference into four equal parts. (2) Copy a (vertical) line A B, and on it construct an equilateral triangle. (3) Make a triangle on a base of 2½ inches, and the angle at the apex 90°.



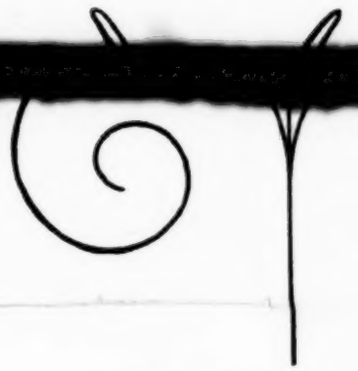


STANDARD VII. Geometry.

A. Plan of a cone is given. Draw elevation and section.

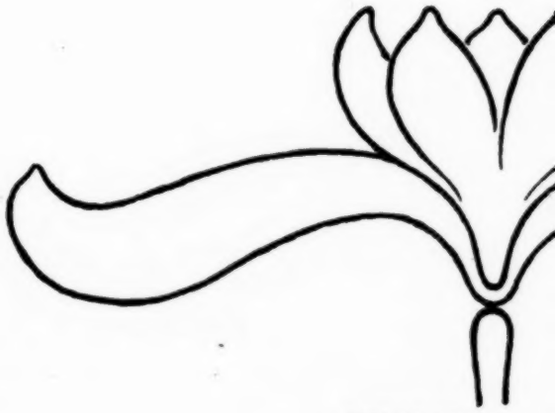
B. Elevation of a square prism, with a circular slab resting on the top is given. C D is equal to an edge of the base. Draw plan and section.

STANDARD IV. Freehand.



STANDARD IV. Fr

STANDARD VI. F



STANDARD V. F

STANDARD VII. Freehand.
Poynter's Drawing

LONDON
JOSEPH HUGHES & CO., FROEBEL HOUSE,

ARD IV. Freehand.

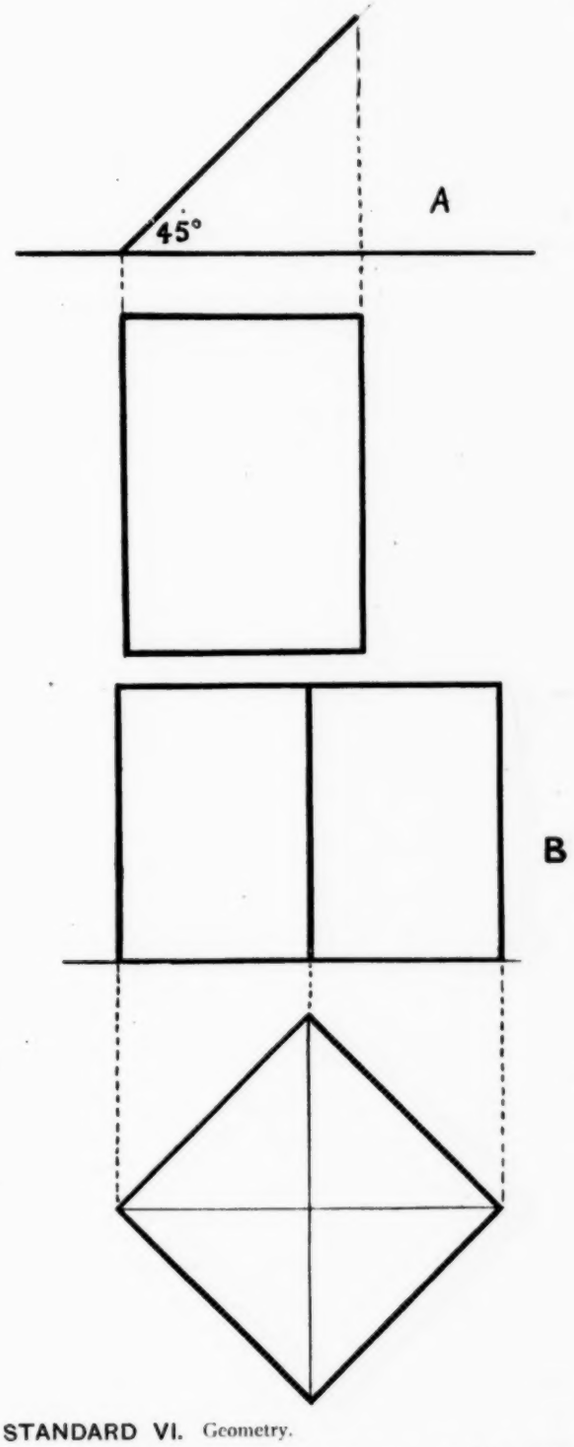
DARD VI. Freehand.

DARD V. Freehand.

. Freehand. Jar, with handles, from
ynter's Drawing Book.

A ⊙ (2) Copy the points A B C, and describe a circle
⊙ C to pass through them.

⊙ B (3) The side of a hexagon is 1 foot 2 inches long. Draw the hexagon. (Scale 1¼ in. to a foot.)



STANDARD VI. Geometry.

A. Elevation of a square, two sides parallel to each plane is given. Draw the plan.

B. Plan of a cube resting on the H. P. is given. Draw elevation.

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